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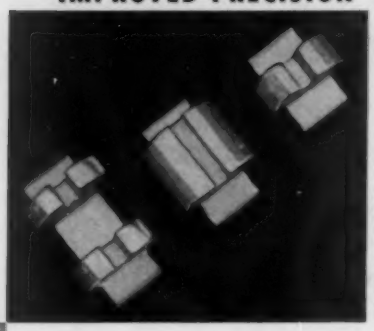

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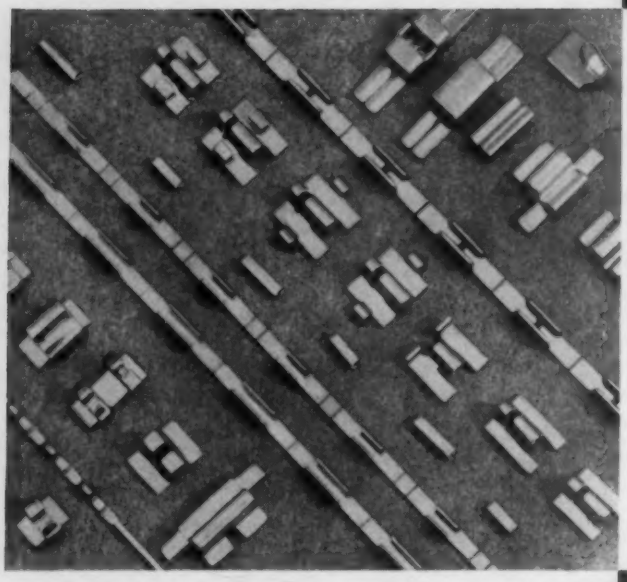

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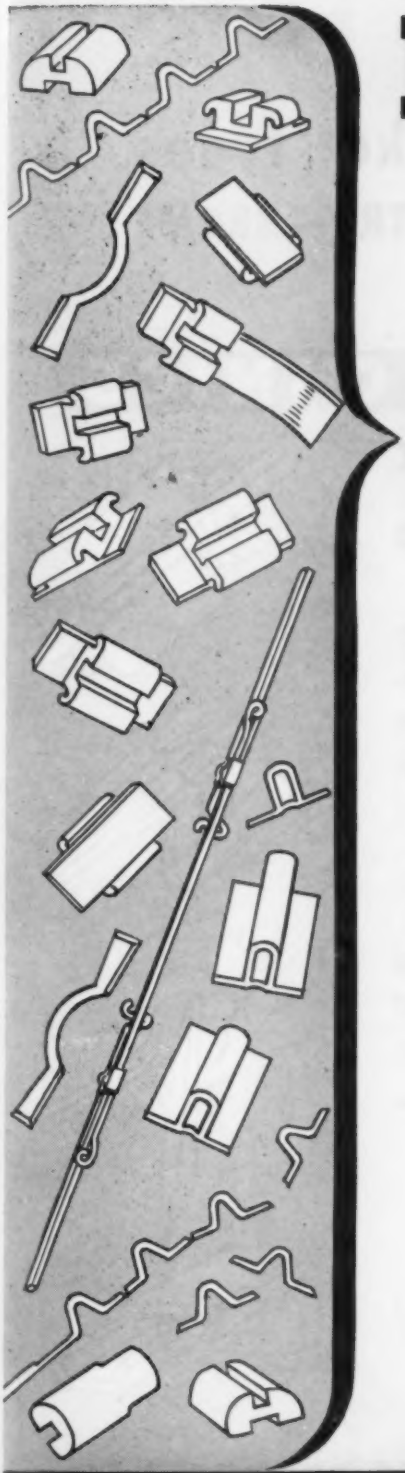

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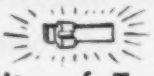
With the addition of the Edgewise Rotation Bracket  the already tremendous popularity of Tru-Chrome Edgewise appliances has been greatly enhanced. Their terrific hardness resists wear. They cannot tarnish.

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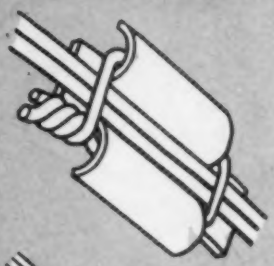

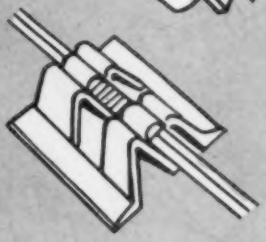

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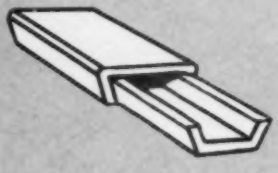

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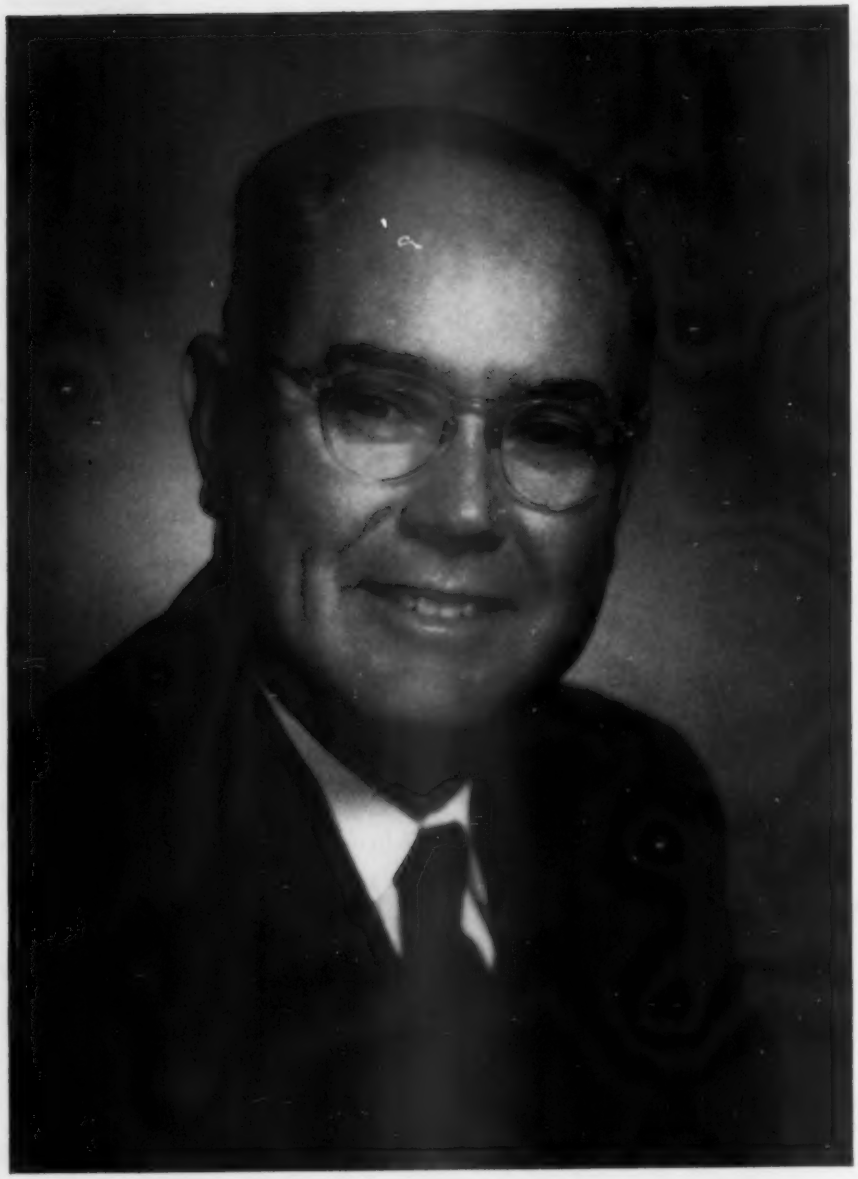

Brooks Bell, President of the American Association of Orthodontists
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Original Articles

PRESSURE HABITS, ETIOLOGICAL FACTORS IN MALOCCLUSION

ERNEST T. KLEIN, D.D.S., DENVER, COLO.

THERE is no tissue in the human body which the orthodontist should know and understand more intelligently than living bone. "Although living bone feels hard and rigid to the touch of the hand, it is the most plastic structure in the whole organic complex and should be so considered by the orthodontist."[1]

Bone is an ever-changing tissue that constantly is being repaired and replaced from infancy to old age. Sicher[2] tells us that, although bones are permanent structures in our bodies and although we have no more bone at any part of our bodies than is reasonably needed plus a certain amount for marginal safety, constant daily repair goes on just as it does in our famous cathedrals. Scaffolds always can be seen on the sides of these cathedrals where workmen are replacing defective stones with solid ones, so that the structure is in constant repair. In like manner, bone constantly is being repaired and replaced. Sicher believes that one cannot grow or destroy bone but merely stimulate it. He says that bone never grows under pressure but that cartilage grows under pressure and, in turn, is replaced by bone. Sir Arthur Keith[3] declares, "Osteoblasts at all times build or unbuild according to the stress to which they are subjected." On the other hand Wolff[16] believed that pressure, not tension, is the cause of bone development. The amount of growth in bone depends upon the need for it.

Although bone is extremely susceptible to the guidance and influence of pressure and stimulus, the extent to which bone can be changed with pressure or stimulus is controversial. Conservative authorities on bone growth believe that orthodontic treatment (intentional pressure) cannot change basal bone; due to the hereditary factor, the pattern of the basal bone remains the same. However, even the most conservative group will agree that alveolar bone can be changed and the teeth in that bone regulated with orthodontic treatment. *Pressure habits (unintentional pressures) also change alveolar bone and move teeth in that bone because the bone-building cells on the receiving end of the stimulus cannot differentiate whether that stimulus is intentional (planned orthodontic treatment) or whether it is unintentional (abnormal pressure habit).* Since changes take place in the bone whether the stimulating factor is intentional or unintentional, one cannot deny pressure habits as an etiological factor in mal-

Read before the Rocky Mountain Society of Orthodontists, Nov. 6, 1951.

occlusion without denying the accepted principle of planned orthodontic treatment.

Occipital and parietal bones of the skull hold the brain case, are hard, and can stand pressure, while the face, with its cartilaginous bone, yields easily to stimulus and pressure, especially during growth spurts, and presents the most complicated growth problem in the entire skeleton since the greatest growth changes in the head are made by the facial structures. Strang[4] states: "The face increases in size about 12 times from birth to adolescence, while the cranium increases only about four times." Since the greatest growth changes in the head are being made by the facial structures, it logically can be assumed that all abnormal pressures should be kept from this most vulnerable target, the face. It is during the transition from the deciduous to the permanent arch that much of the damage takes place, and it is during this transition stage that the avoidance of all abnormal pressure habits is of the utmost importance. One may argue that oftentimes children with abnormal pressure habits have well-developed faces and have no malocclusion, and how then can these same habits cause facial abnormalities in other children? Fluhrer[5] gives this explanation: Healthy bone grows and is influenced by environmental factors such as abnormal pressure habits. Bone that has a "disturbance in ossification, caused by ill-health, improper diet, or endocrine disturbances resulting in 'bone fatigue' does not grow and consequently is not changed by environmental factors such as abnormal pressure habits. The latter cases are the exception rather than the rule." By the same token, it may be explained why some cases of malocclusion respond to planned orthodontic treatment while others with the same malocclusion and receiving the same planned orthodontic treatment do not.

All pressures fall into one of two classifications, either intentional or unintentional. The intentional are the planned pressures, and the unintentional are the abnormal pressure habits. The unintentional or abnormal pressure habits are of three types: (1) intrinsic or pressure habits within the mouth; (2) extraneous or extrinsic, abnormal pressure habits on the face; and (3) functional pressures.

The effects of pressure habits on bone have been known to the orthodontic profession for a long time. Intrinsic pressure habits such as thumb-sucking, finger-sucking, lip biting, tongue thrusting, mouth breathing, etc., were recognized as harmful, and efforts were made to eliminate the habits long before the extraneous (extrinsic) pressure habits such as chin propping, face leaning on forearm or hands, and abnormal pillowing positions were believed to aggravate malocclusion. As early as 1903, George T. Baker[7] attributed a case of malocclusion to a sleeping habit in which the child exerted constant pressure against the mandible. In 1920, Calvin Case[7] explained lateral malocclusions by the pillowing habits of early infancy. While at Dr. Angle's school, Atkinson[6] was perhaps one of the first to make mention of the possibility that "special sleeping habits" could cause malocclusion. He was referring to extraneous (extrinsic) pressure habits such as chin propping, face leaning on forearm and hands, and abnormal pillowing positions rather than the intrinsic pressure habits which had been recognized and accepted for some time previous. Harvey Stallard,[7] who was at Dr. Angle's school at the same time, was deeply impressed by the sug-

gestion and, in the fall of 1920, made a personal survey of the sleeping habits of children. He first asked the parents how their children slept, but he soon became convinced that parents are poor observers, and so he resorted to making visits to bedsides to study personally those suspected of using extraneous pressure. After studying some 300 individuals in their sleeping environment, he published a preliminary report in the *Dental Cosmos*, 1923, of his conclusions that cross-bites and saddle-shaped and V-shaped dental arches are the result of hand, arm, shoulder, and face pillowing. This probably was the first extensive report on extraneous (extrinsic) pressure habits ever published.

William Roy Humphrey,[8] associated with the late Albert H. Ketcham from 1918 until Ketcham's death in 1936, recognized the importance of intrinsic pressure habits from the very beginning of his orthodontic practice. Ever since Stallard made his first report on extrinsic pressure habits in the *Dental Cosmos* of 1923, Humphrey has considered extrinsic pressure habits as an etiological factor in malocclusion. He states, "After employing both uninterrupted and intermittent pressure in the treatment of orthodontic cases for many years, I am of the opinion that if one does not include external pressure habits (unintentional pressures) as an etiological factor in malocclusion, the entire treatment concept of modern orthodontic therapy is denied. Of course, such an etiological factor as pressure habit is often superimposed upon one or more of the following: nutritional factors, endocrinopathies, untoward hereditary factors, pathological entities."

Alfred Paul Rogers,[9] often-quoted authority on myofunctional treatment of malocclusion, in a personal letter dated June 27, 1950, wrote: "It is a well recognized biological fact that structural form is influenced by pressures due to abnormal neuro-muscular activity; the converse being true that normal pressures, due to function, tend toward normal form in the osseous structures." Johnson[1] reached the same conclusion and is often quoted as saying, "Normal habits maintain normal structural form; abnormal habits maintain abnormal structural form." Is it not logical, therefore, to attempt to eliminate all abnormal habits (abnormal neuromuscular activity), all pressure habits which tend to stimulate, develop, and maintain alveolar bone and the teeth in that bone in abnormal structural form?

Since a picture can put an idea across more effectively than thousands of words, let us examine some photographs that illustrate how pressures change living bone. These photographs illustrate how pressures, whether intentional or unintentional, produce changes in living bone. An effort was made to collect as much pressure habit data, from every available source, as possible.

CLASSIFICATION OF PRESSURE

I. Intentional pressure (planned pressures)
   - A. Orthodontic treatment appliances
   - B. Myofunctional therapy[9]
   - C. Intentional head deformation[11] (Fig. 1)
   - D. Giraffe-necks of the Padaung women[12] (Fig. 2)
   - E. Chinese custom of foot binding[13] (Fig. 3)
   - F. Reshaping horns of cattle[14] (Figs. 4 and 5)

II. Unintentional pressure (abnormal pressure habits)

A. Intrinsic pressure habits (within the mouth)

1. Thumb-sucking (Fig. 6)
2. Finger-sucking
3. Tongue-sucking
4. Lip-sucking
5. Cheek-sucking
6. Blanket-sucking
7. Nail biting
8. Lip biting
9. Tongue biting
10. Tongue thrusting (Fig. 7)
11. Macroglossia, overgrowth of the tongue
12. Incorrect swallowing, anesthesia throat[6, 18, 19] (Fig. 8)
13. Mouth breathing

B. Extraneous (extrinsic) abnormal pressure habits (face)

1. Chin propping (Fig. 9)
2. Face leaning on hand (Fig. 10)
3. Abnormal pillowing positions, leaning on forearm or hand[8] (Figs. 11 and 12)
4. Habitually sleeping on the right side of the face may cause the nose to turn leftward or vice versa; a deflected septum may also result from this sleeping habit[7]

C. Functional pressures

1. Bowlegged cowboy (sprung legs) (Fig. 13)
2. Warping bones of the foot by wearing shoes that do not fit properly
3. Narrowing the external auditory meatus on one side by sleeping on that side of the head more than on the other
4. Flattening of an infant's head by laying infant habitually in one position for prolonged periods. Today, mothers do not permit their babies to lie too long in one position but turn the infants frequently.
5. Flattened Indian skulls, base of skull mushroomed over spinal column caused by carrying heavy loads on their heads throughout their lifetime[6]
6. Malocclusion frequently developed in musicians from pressure exerted on their teeth or face
7. Kyphosis or round shoulders common among dentists, school children, tailors, cobblers, carpenters, and laborers, caused by occupational pressures
8. A bent and sometimes notched breastbone of chickens and turkeys that roost in trees from the pressure exerted[20]
9. Spinal curvature can result from abnormal sleeping positions and postural irregularities[7]
10. Many other occupational and functional pressures not mentioned.

Skulls of the Pueblo Indian Square Head and the Flathead Indians show the effect of pressure on living human skulls. Fig. 1 demonstrates how the Flathead Indians tied their papooses to boards to produce the flat heads which they admired.

Deformation of the human head has been known since the writings of Herodotus and was very common among the Natchez Indians along the northeast coast of the Gulf of Mexico and the northwest coast from South Oregon to Vancouver. It became fixed through long practice and was considered a mark of distinction and superiority.

Fig. 1.—Flathead Indian papoose tied to boards to produce flathead-shaped skull (intentional, planned pressure).[11]

The effects of these various head deformations on brain function and growth as well as health of the individual apparently are insignificant. The hereditary effects are perceptible; the deformation, once acquired, persists throughout life. The custom of head deformation among the Indians is gradually decreasing, and the indications are that in a few generations it will cease to exist.

Whereas the Indians warped the head bones intentionally, modern Americans warp their faces and jaws unintentionally with abnormal pressure habits.

The Padaung women, Karen Group, who live in Burma, adjoining India on the Northeast, are remarkable for the amount of brass wire used for coiling around their necks. They begin with five coils as thick as the little finger and add more as the neck stretches until twenty-one coils are reached. The weight of the

metal is sometimes eighty pounds. The gradual addition of wire coils around the neck produces a pressure and an elongation of the individual's neck, causing that individual to become "giraffe-necked."[12] (Fig. 2.)

Foot binding was prohibited by the new laws of the Chinese Republic in 1921. The custom was more than seven centuries old and originated from the desire of men to keep their women from running away.

At one time, unbound feet were taxed heavily; today, bound feet are taxed, the money being used to support schools for young girls throughout China. No longer do small girls shriek with pain as their feet are tightly bound because this ancient custom is being stamped out—stamped out partly by a still older belief of Confucius that the physical body never should be mutilated or destroyed. (Fig. 3.)

Fig. 2.—Padaung woman, Karen group. Sculpture in bronze by Malvina Hoffman, Field Museum of Natural History, Chicago.[12]

Many stockmen shape the horns of their stock for show by placing one-half-pound lead weights on the tips of the horns of the animals when they are 8 to 10 months old. Treatment is intermittent for two-week periods until the desired shaping has been attained, at which time the weights are removed with no danger of relapse occurring. In case reshaping is not effective with one-half-pound weights, the weights may be increased up to one-and-one-half-pound weights. The change in horn position is not in the horn itself but at its growth sites where it is attached to the frontal bone. As stated previously, once the horn is shaped, it does not relapse. (Figs. 4 and 5.)

Horns are a protection but can be detrimental if not properly shaped. Packing houses sometimes cut down as much as 25 per cent on cattle that have been injured by each other's horns. As a result, many stockmen are breeding out horns—producing hornless breeds.[14]

Charles Waldo,[21] who conducted numerous experiments at Harvard University on deer's antlers, reports that the horns of cattle are a permanent process of the frontal bone and are not shed like the deer's antlers. They are composed of cancellous bone and grow in length chiefly at the base of the horn while the antlers of the deer have a compact periphery and grow at their tips, leaving behind a column of bone.

Fig. 3.—Chinese feet cruelly mutilated, the instep broken to keep the feet within a three-inch measurement (intentional, planned pressure).[13]

Albert H. Ketcham[15] used to have some data on a herd of seventeen long-horned steers shipped from Texas to the Oklahoma Park Department. One of the animals was sent to a small park in western Oklahoma where, after a few months, its horns drooped until they projected beyond its nose. The animal could not eat and was killed. A subsequent analysis of the soil revealed a severe mineral deficiency. In this case, the growth sites at the bases of the horns were affected and, as usual, new bone was formed but it was poorly calcified and too soft to support the weight of the horns, the weight of the horn itself causing it to droop downward.

It has been found that breastbones of chickens and turkeys can be prevented from being bent to one side or becoming notched when the chickens and turkeys roost in trees if the birds are fed bone meal, commercial limestone, and oyster shells, a diet rich in calcium.[20]

Fig. 4.—Weights attached to horns which produce desired horn positioning. *a*, One-half pound lead weight attached to horn of 8-month-old steer; *b*, weights with straps and springs used to place pressure in the desired direction to move horns to desired shape; *c*, one pound lead weight illustrating screw with which it is attached to horn.

A. *B.*

Fig. 5.—*A*, Herd of Hereford cattle showing horns which are not properly shaped and which have not been treated with weights.[14]

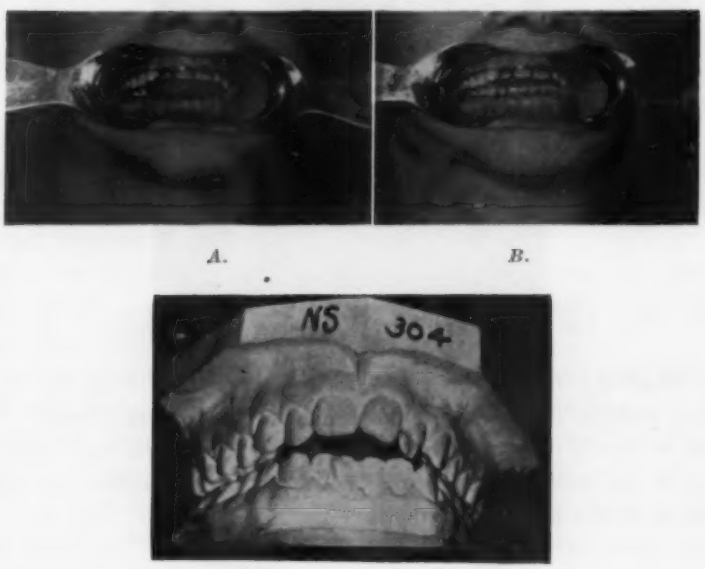
B, Two-year-old Hereford bull showing properly shaped horns after treatment with weights (intentional, planned pressure).[14]

These are examples of how two or more etiological factors sometimes are superimposed upon each other.

Thumb-sucking habits, unintentional pressures (intrinsic), at an early age are a normal act; continuation of the habit past the age of permanent dentition may cause a malocclusion (Fig. 6).

A. *B.*

Fig. 6.—*A* and *B*, Thumb-sucking habit and result.



A. *B.*

C.

Fig. 7.—*A*, *B*, and *C*, Tongue thrusting habit and result (unintentional pressure). Tongue is thrust between anterior teeth during each act of swallowing. In *B* note how the lingual tongue habit reminder prevents the tongue from thrusting into open-bite.

TONGUE HABITS

The tongue is a powerful muscular organ which exerts tremendous pressure at frequent intervals, twenty-four hours a day, during the nighttime as well as during the day.

In tongue thrusting habits (Fig. 7), a normal-sized tongue or one that is overdeveloped is thrust between the upper and lower teeth each time the patient swallows, producing an open-bite. Sometimes the patient allows the tongue to rest in the open-bite space between acts of deglutition, preventing the bite from closing. Tongue thrusting also permits the molars to elongate, a condition which further complicates the problem of correcting open-bite cases even if tongue thrusting habits have been corrected.

In macroglossia, overgrowth of the tongue, pressure is exerted against the lingual surfaces of the teeth, causing them to become spaced. Indentations on the tongue often appear where the tongue pushes against the teeth. A sharp filling or tooth may cause a normal-sized tongue to travel to the source of irritation so frequently that the tooth with the sharp point will move out of the line of occlusion in the direction the tongue is pushing.

When you observe an open-bite or spacing of the teeth, examine the tongue for size as well as for its behavior when in the act of swallowing or speaking. Invariably you will discover that the tongue is being forced through the space which it undoubtedly produced in the first place. Test the palate for "anesthesia throat."

Fig. 8. (Courtesy, Dr. Spencer R. Atkinson.)

Tongue sucking, tongue biting, tongue thrusting (Fig. 7) and other abnormal tongue habits, as well as macroglossia, anesthesia throat (Fig. 8), and sharp fillings on teeth produce abnormal pressures which can develop an open-bite, spacing of the teeth, overdevelopment of the mandible, as well as an unnatural position of the mandible and the condyle.

"ANESTHESIA THROAT"

"Anesthesia throat" is a term coined by C. F. Stenson Dillon[18] to describe a throat which has no sensory nerve supply and is immune to sensation. The individual has no normal impulse to swallow nor will she gag upon touching the uvula, velum palatinum, or any of the usual trigger points in the throat. In order to swallow, she must seize the tongue between the anterior teeth and, by dint of muscular contortions involving even the face (as illustrated in Fig. 8), perform the act of deglutition. What chance has anyone to correct and maintain

the correction of an open-bite under such circumstances? One can determine this condition by watching closely the efforts of the patient to swallow and then, by means of a mouth mirror, test the swallowing reflexes. Trouble, disappointment, and much unrewarded effort can be avoided by this simple test.

INCORRECT SWALLOWING HABITS

The following clinical observation regarding improper swallowing habits is made by Atkinson[6]:

Hold your hand on the chin of the patient while the patient is in the act of swallowing. If the jaw is opened during the act of swallowing, it is an indication that the swallowing is done improperly. If the jaw opens during the act of swallowing, the suprahyoid muscles will pull the body of the mandible downward, bending it just anterior to the angle of the jaw, causing tendency for an open-bite. If the jaws are closed during the act of swallowing, it is impossible to produce this bending of the mandible just anterior to the angle of the jaw. Open-bites are all typical—bent down just anterior to the angle of the jaw.

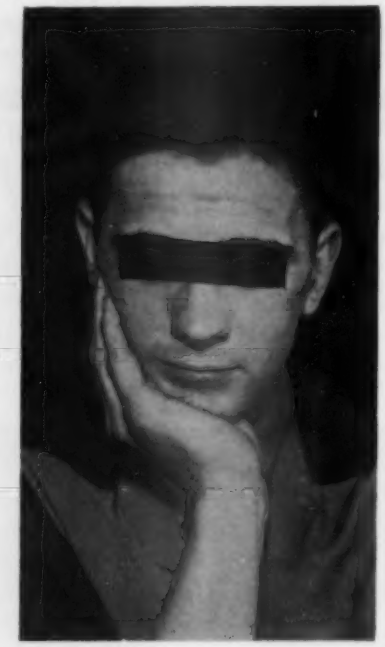
Straub[19] draws the following conclusions:

1. The perverted swallowing habit seems to be the direct result of improper bottle feeding.
2. The perverted swallowing habit may separate not only the anterior teeth but also most of the posterior teeth including the premolars and, in rare instances, the first molar unilaterally.
3. In many perverted swallowers, the palate is so high and narrow that the child cannot place his or her tongue in its correct position due to its size, even if the child wished to, until proper corrections have been made.
4. The perverted swallowing habit may be present with other interference habits such as thumb-sucking or finger-sucking, lip biting, tongue thrusting, nail biting, and leaning habits.
5. It seems to be more prevalent in the female than the male, but this should be discounted as parents may be more concerned with slight irregularities in their daughters' rather than in their sons' teeth.
6. The perverted swallowing habit should be detected and corrected early to facilitate normal development of the palate and dentitions. In its early detection, it should be corrected immediately with a mechanical appliance to limit the tongue to its proper position. It is a very difficult habit to correct in older patients, and there is some danger that after fourteen to sixteen years of swallowing incorrectly these patients may return to the old perverted swallowing habit after all the appliances have been removed.

Mouth breathing may also cause an open-bite. The nose is the air conditioning plant of the body, and failure properly to condition the air we breathe produces harmful effects other than malocclusion.

If there is a nasal obstruction, correction of this defect is imperative before the mouth breathing habit can be corrected. In clinical examination, tip the patient's head back. Invariably you will discover that the mouth breathers with nasal obstruction have narrow, undeveloped nares.

The late Bernhard Gottlieb[17] made the observation that "Closed bites are rare among the people who live in Europe. They rarely chew gum. Closed bites are very common in gum chewing America. Gum chewing is done mostly on the posterior teeth which might cause them to depress and further the eruption of the anterior teeth, developing excessive closed bite."



A.

B.

Fig. 9.—*A* and *B*, Chin propping habit and result.

Like most discussions of a living problem in science, this observation ends, metaphorically, not with a full stop but with a question mark: "Is gum chewing a factor to be considered in closed bites?"

CHIN PROPPING HABIT

A chin propping habit (extraneous or extrinsic pressure, unintentional) will cause a deep anterior closed bite as is illustrated in Fig. 9, and may also cause

the mandible to be in retraction. Note how little of the lower anterior teeth is visible when the jaws are in a closed position.

FACE LEANING

Lateral pressure from face leaning (extraneous or extrinsic pressure, unintentional) may cause a lingual movement of the maxillary teeth on that side, the mandible being less affected because it does not have a rigid attachment and

A.

B.

Fig. 10.—*A* and *B*, Face leaning and effect on the mandible and maxillary arch.

can slide away from the pressure. Fig. 10 illustrates how the mandible swings to the left with the pressure, the maxillary arch receiving the stimulus or pressure on the right side.

EXTRANEOUS PRESSURE HABITS AFFECT THE MANDIBLE

Brodie[22] observes, "Normally the mandible travels from its rest position to full occlusion (a distance of about 3 mm.) by strictly rotational movements, the condyle acting as a pure hinge. It is only during this movement that the teeth can exert any influence on the mandible. If any tooth interferes with the normal path of closure, the mandible is deflected, bringing undue stress on the

Fig. 11.

Fig. 12.

Fig. 11.—Abnormal pillowing position—chin leaning on forearm (unintentional extraneous or extrinsic pressure). (Humphrey, 1927.[8])

Fig. 12.—Abnormal pillowing position—face and chin leaning on hand (unintentional extraneous or extrinsic pressure). (Humphrey, 1927.[8])

offending tooth and abnormal shifting of the condyle in the fossa. Such shifting may be in any direction." Extraneous pressure habits such as chin propping (Fig. 9), face leaning on the hands (Fig. 10), abnormal pillowing positions (Figs. 11 and 12), or abnormal tongue habits (Fig. 7) also may guide the mandible and the condyle into unnatural positions.

When the mandible is moved from an abnormal position into a normal position and it functions and is retained in this new position, it is considered having been positioned into normal function. This process should not be referred to as "repositioning of the mandible" but as "positioning of the mandible." The mandible is "positioned" when it functions normally, the condyle acting as a pure hinge; the mandible is out of position and needs "positioning" if the mandible in its normal hinge movement is deflected during its normal path of closure by some abnormal interference such as a premature tooth contact or abnormal extraneous pressure habits. Humphrey[8] confirms this observation.

The etiology of malocclusion is infinitely complex; and, although abnormal pressure habits definitely are a factor that must be considered in the study of the cause of malocclusion, abnormal pressure habits are by no means the complete answer to the orthodontist's problem. The etiology of malocclusion is not as simple as that.

Fig. 13.—Cowboys who ride horses day after day become bowlegged (sprung legs) because of the pressure exerted (unintentional) on their legs.[25]

It is generally accepted that dental and facial deformities may be the result of many etiological factors, such as hereditary factors, environmental factors, nutritional factors, endocrine dysfunction, premature loss or prolonged retention of deciduous teeth, malformed or supernumerary teeth, loss of permanent teeth, pathological entities, as well as abnormal pressure habits, all of which may function singly or be superimposed upon each other.

Heredity and environment are two very important active factors in the etiology of malocclusion. Heredity is sealed when fertilization takes place. In other words, there are some patterns handed on by our ancestors which cannot be changed thereafter. To be perfect, therefore, we must choose our ancestors. There may be political equality but never biological equality.[23]

Galton's law of bisexual heredity quotes the mathematical proportion that can be inherited from our forefathers.[16]

½ is derived from the parents
¼ is derived from the grandparents
⅛ is derived from the great-grandparents
1/16 is derived from the great-great-grandparents, etc.

After heredity is sealed, the great environmental or acquired influences which include all the pressures, intentional and unintentional, begin to play their part.

Although heredity has determined certain patterns so that the orthodontist is limited to what he can hope to accomplish, heredity cannot be used as a waste-basket for his failures.

In discussing heredity and environment, A. LeRoy Johnson[1] says that an orthodontist never treats the normal denture. He treats only abnormal cases in which normal development has been interfered with. Use of a muscle develops that muscle, and disuse soon causes it to atrophy. The question is, "Are these effects inherited?" Did the giraffe get his long neck because he browsed on trees, or did he browse on trees because he had a long neck? The consensus of opinion is in favor of the second of these alternatives.

Without underestimating the important position all factors hold in diagnosing the causes of malocclusion, giving each factor the careful consideration it has earned and rightfully deserves, abnormal pressure habits still should occupy a prominent place in the orthodontist's diagnostic armamentarium.

When a patient asks the orthodontist whether or not orthodontic treatment is indicated and if he will guarantee that he can establish a functional occlusion and maintain it without relapse, the orthodontist is safe in stating that although a tooth that is not in function is a sick tooth, to the best of his knowledge no one has ever died because he had "crooked teeth." He might then well ask himself, "Am I capable of achieving the result the patient requires? If this patient were my own child, would I treat?" In all fairness, the orthodontist should then inform the patient that he feels that he can or cannot develop or grow the malocclusion into functional occlusion duplicating the guarantee the Creator gave the patient.

In making a diagnosis of malocclusion, the orthodontist must make a "scientific guess" and, as Waugh[10] says, "Think into the tissue." Orthodontists need to think in terms of biology and allied subjects, growth and development, and pressure habits. There are many orthodontists who pay no attention to anything but orthodontic mechanics and appliances. The most successful orthodontist is not necessarily the one most expert in wire manipulation and in the fabrication of appliances, the "mechanical orthodontist" as Rogers[9] calls him. The problem is not only mechanical but also biological. Johnson[1] substantiates this belief when he writes, "Failure is a result of ignoring laws and principles of development that characterize all living things, conception of the 'orthodontic creed,' and the belief that orthodontia involves nothing but mechanics. Mechanical treatment in orthodontics is essential, but the knowledge back of it that

specifies each step in the procedure fortifies against the unexpected, tells him when to start and when to stop, is not found in the mastery of technique. Knowledge of this kind is found in science that treats of vital phenomena . . . in biology and allied subjects."

The late Oppenheim[24] said, "Appliances do not get results; osteoblasts do the work." For years he was an exponent of the theory that one can move teeth faster and retain their position better if a gentle, not heavy, pressure, a mere caress, is applied only intermittently, instead of continuously. Actually, appliances that we assume apply continuous stimulus or pressure soon expend their force as the tooth moves away from the appliance and a rest period follows until the next adjustment of that appliance.

Mechanical orthodontists may have the ability to move teeth, but their success in retaining them and preventing a relapse is not nearly so great as that of the orthodontists who not only are mechanical but also understand the laws and principles of growth and development. It has been said that orthodontists can move the teeth where they want them; but, when they complete treatment, nature will move the teeth where she wants them unless the biological laws of nature have been complied with. This knowledge of growth and development tells the orthodontist "when to start and when to stop, fortifies him against the unexpected."[1] He grows the teeth and jaws into functional occlusion by removing interference, and then he has greater success in retaining them, reducing the number of relapses by eliminating the factors which contribute to the cause of the malocclusion in the first place and which, if permitted to remain active, could work against retention.

By eliminating abnormal pressure habits, unintentional pressure, the orthodontist and the patient can suffer no possible detrimental effects. Unattractive habits of leaning, propping, pillowing, and slouching are replaced by normal and attractive habits. Intentional pressures of planned orthodontic treatment get better response when unintentional pressures of abnormal pressure habits are not working against them. Abnormal pressure habits, unless eliminated, remain active to combat planned orthodontic treatment and are an active factor in causing relapse of treated orthodontic patients. Is it not logical, therefore, to eliminate everything that aggravates malocclusion, everything that nullifies the plan of orthodontic treatment, and everything that is a potential factor in causing treated orthodontic cases to relapse? Neither the patient nor the orthodontist possibly can lose by eliminating abnormal pressure habits; no possible harm can result—they have nothing to lose and everything to gain.

Prevention of malocclusion is a responsibility that should be accepted and thoroughly studied and understood by the family dentist as well as the orthodontist. The family dentist cannot escape the responsibility to his patients of recognizing early some of the factors which cause malocclusion, of helping the patient overcome them, and of advising the patient to consult an orthodontist in time if treatment is indicated. "The dentist always should remember that, since he can see only what he knows, it behooves him to study the etiology of malocclusion so that he will know what he sees."[16] By recognizing and discontinuing pernicious abnormal pressure habits and other etiological factors at an

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early age, aggravated and complicated malocclusion can be prevented, a program of prevention of malocclusion can be instituted, and much good can be accomplished.

SUMMARY OF POOLED INFORMATION

1. Living bone is an ever-changing tissue that constantly is being repaired and replaced from infancy to old age.

2. Living bone is extremely susceptible to the guidance and influence of pressure and stimulus.

3. The extent to which living bone can be changed with pressure or stimulus is controversial. However, even the most conservative group will agree that alveolar bone can be changed and the teeth in that bone regulated with orthodontic treatment (planned, intentional pressure).

4. Abnormal pressure habits (unintentional pressures) also change alveolar bone and regulate teeth in that bone because the bone-building cells on the receiving end of pressure or stimulus cannot differentiate whether that pressure or stimulus is intentional or unintentional.

5. Since changes take place in living bone whether the stimulating factor is intentional or unintentional, one cannot deny abnormal pressure habits as an etiological factor in malocclusion without denying the accepted principle of planned orthodontic treatment.

6. The face, with its cartilaginous bone, yields easily to stimulus and pressure, especially during growth spurts, and presents the most complicated growth problem in the entire skeleton. Since the greatest growth changes in the head are being made by the facial structures, it logically can be assumed, therefore, that all abnormal pressures should be kept from this most vulnerable target, the face.

7. It is during the transition from the deciduous to the permanent arch that much damage takes place, and it is during this transition stage that the avoidance of all abnormal pressure habits is of the utmost importance.

8. Some children with abnormal pressure habits have well-developed faces with no malocclusion. How, then, can other children with the same abnormal pressure habits have facial abnormalities? Fluhrer[5] believes that healthy bone grows and is influenced by environmental factors such as abnormal pressure habits. Bone that has a "disturbance in ossification" caused by ill health, improper diet, or endocrine disturbance, resulting in "bone fatigue," does not grow and consequently is not changed by environmental factors such as abnormal pressure habits. By the same token, it may be explained why some patients with malocclusion respond to planned orthodontic treatment while others with the same apparent malocclusion and receiving the same planned orthodontic treatment do not.

9. The etiology of malocclusion is infinitely complex and, although abnormal pressure habits are a factor that must be considered in the study of the cause of malocclusion, they are by no means the complete answer to the orthodontist's problem. Dental and facial deformities may be the result of many etiological factors, such as nutritional factors, hereditary factors, environmental factors, endocrine dysfunctions, premature loss or prolonged retention of deciduous

teeth, malformed or supernumerary teeth, loss of permanent teeth, pathological entities, as well as abnormal pressure habits, all of which may function singly or be superimposed upon each other.

10. Normal habits maintain normal structural form; abnormal habits maintain abnormal structural form (Johnson).

11. The mechanical orthodontist may have the ability to move teeth but his success in retaining them, preventing a relapse, is not nearly so great as that of the orthodontist who not only is mechanical but also understands the laws and principles of growth and development.

12. The orthodontist and the patient can suffer no possible detrimental effects by eliminating abnormal pressure habits. It is logical to eliminate everything that aggravates malocclusion, everything that nullifies the plan of orthodontic treatment, and everything that is a potential factor in causing treated orthodontic cases to relapse.

13. Prevention of malocclusion is a responsibility that must be accepted by the family dentist as well as by the orthodontist.

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THE ACTIVITIES THAT MARK AND MAKE A PROFESSION AND ACHIEVEMENTS THAT AID IT TO MEET THE DEMANDS OF THE DAY

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AS WE complete fifty years of our existence it is appropriate for us to review our position. The invitation to do so was accepted without misgivings but the paper was written under entirely different circumstances. I found in doing so that no paper involved so many problems with so much detail and very few have weighted me with greater responsibility. It was not my intention to make this a lengthy paper, though even with severe pruning it became unusually long for we have had a busy fifty years. I came to the conclusion that detailed enumeration of professional progress would serve no useful purpose, for our specialty is young enough for a large number of our members to have a personal knowledge of what has happened. Neither would a chronological outline of important events with a consistent mentioning of individual contributors have any advantage. A consideration of their effect and a comprehension of their present status will, I believe, have significant value.

In his first letter Dr. Braun wrote of rumors that orthodontics may again be at a "crossroad." Instead of being concerned about that possibility I look upon it with equanimity, for a review of the past will prove that we have the ability and the vigor to cope with our problems. Rumors are risky things and are frequently unsupported by facts. Therefore, while rumors may be given some attention they should be accepted with reservation. The term "crossroad" may have many meanings but we think of it usually as indicating that a point has been reached where an account must be taken, a survey made, a decision reached as to what is the best course to pursue. Many of you as youngsters lived, as I did, in the country. As we walked or rode we would come to a real crossroad where we did not know the way to turn. Our decision was not always right and sometimes we would take a longer, even rougher way, but in the end we did reach our destination. Over the years dentistry and orthodontics have come to many crossroads. Hesitation, indecision, and lack of knowledge as to what to do made many of the moments dark and full of frustration. We floundered a bit but we did progress, and some of our destinations have been reached. There has been an integrity and dignity in our methods, and because of that we have enjoyed professional and public confidence. The specialty has not indulged in sensationalism and we have been reasonably free of the disservice of criticism and similar unworthy actions which eventually handicap progress. The objectives of our specialized field have not been endangered by the unfortunate excuse offered by the weakling that the end justifies the means. We have been able to provide increasing health benefits to the public through better

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methods of practice, and the improvement in our professional stature is a reminder to the younger group that they have a great responsibility as new issues challenge their ability and determination.

EDUCATION

The lifeblood of any group is the education of its members. Advancement of learning is one issue no profession can afford to ignore. We have not done so. We have been impressed with certain fundamental values and have encouraged a gradual tightening of requirements which are intended to create a better dentist and a better specialist. Some of you will recall that had you wished to attend a university graduate course in orthodontics none would have been available. Essential training had to come from association with another orthodontist or from a short-term proprietary course. The *former* did sharpen clinical experience but did not provide a specialty *education*, and the *latter* was frowned upon as not providing enough instruction for competency. The basic fault of each special training effort was that it was *instructive*, not educational. Your society has a requirement for membership which emphasizes this point. It is more stringent than most societies and was devised no doubt to stimulate the prospective orthodontist to seek the fullest possible educational opportunity.

The steps to our present status of orthodontic education were not easy ones. There was little friendship and at times outright enmity among dental practitioners of those early days who sought to devote most or all of their energies to the correction of the irregularity of the teeth. Undergraduate instruction was practically nonexistent and there was no higher level opportunity available to those who felt the orthodontic call. In the midst of this, a resolute and forceful man offered a short course to those willing to meet his requirements. His indoctrination, no matter how disputed in later years, laid a firm foundation and was a source of strength to those who decided to specialize at a time when the term itself was hardly understood.

A person of such determination and positive views could not help but develop contention and dissension. For instance, a great friendship between the teacher and one of his students was abruptly terminated by the teacher when he learned that his former student had joined an orthodontic society of which the teacher did not approve. Even though assailed with such childish difficulty the proprietary schools, as the source of orthodontic instruction, served a useful purpose. They met with reasonable success the demands of the day when the public was less exacting because diagnosis and treatment methods were known to be of a limited nature and on an empirical basis. But the increase in dental patients, the public acceptance of orthodontic service, the accelerated pace of economic and social change characteristic of the twentieth century vastly increased the complexity of our field and led to greater demands for preparation for better service. The proprietary course oddly enough was a real factor in helping to solve this problem for it stimulated the development, and more important for the advancement of the specialty, the initiation and organization of undergraduate courses of orthodontic instruction in dental schools by providing the teachers needed under an expanding orthodontic educational program.

Nearly all of the early graduates found themselves sought after by dental schools as orthodontic instructors. These undergraduate departments have been and are today criticized for inadequacy and lack of instruction uniformity, but I do not believe they deserve all that is said about them. If the number of dental students seeking graduate study in orthodontics is any criterion or the continuous increase in the number of graduate departments any proof,[1] we come to the conclusion that the undergraduate student has learned sufficient to create interest which could be satisfied only by entrance into the orthodontic field. Where else could these students have gotten the urge for the specialty? Have other forms of special dental practice had as many recruits as orthodontics? There must be a basic reason for the rapid increase in the number studying advanced orthodontics, and I give credit for a great deal of the interest to the fundamentally good work done in undergraduate orthodontics. There are other reasons, of course, that have influenced students, but by far the largest group got the urge from what they heard and saw under the supervision of the orthodontic specialist teacher functioning in the undergraduate department of their dental school. These courses do have their weaknesses but one complaint can be replied to in a simple manner. It is almost unbelievable that it should serve as a basis for criticism. I refer to the statement that dental students are not graduated qualified to carry through the treatment of malocclusion of the teeth. It has never been the intent of undergraduate courses to educate the dentist to be the equivalent of an orthodontic specialist regardless of where that dental graduate might be expected to practice. The intent in practically every dental school has been to provide a basic foundation for the dentist so that he might comprehend malocclusion and related complications and be able to advise when advice is sought. That is all there is to it. Those who wish to be able to do more for their patients are encouraged to assume further studies to qualify for the more extensive work they desire to do. That this procedure is generally sound and has merit is indicated by the fact that many *dentists* have pursued further studies and have returned to their communities to carry on treatment of malocclusion either on a part- or full-time basis.

We have, therefore, in fifty years evolved what is a reasonably sound and productive educational effort. Undergraduate *dental* education lays the basic foundation for *dental* graduates, and since the nature of the orthodontic problem indicates that it is better handled by the specialist, graduate schools under university auspices provide the advanced *education*, for one who is to specialize. Unfortunately we are still plagued with a basic weakness. There is a great need in orthodontic practice for clinical *experience* to augment the basic scientific studies of the undergraduate school and the more detailed advanced studies of the graduate school. This lack of clinical opportunity will not ruin a good man but it does him no good. Our orthodontic societies by certain membership requirements have indicated that they recognize this problem and, in a restrictive way, which emphasizes some years of practice before election to full membership, are trying to help correct it. Yet we have no institutions where our trainees may continue to develop slowly but surely their "book larnin'" through clinical practice such as a young physician and surgeon enjoy. We have the

preceptorship which supplies a form of guided and supervised clinical experience but that arrangement is so riddled with faults it cannot be considered as being of much help. I speak with authority on this subject, having begun practice under such an arrangement. This weak link in our educational program merits full thought of the specialty and it is obvious since there has been little improvement in the situation that very little thought has been forthcoming. It is an issue risen from past experience that becomes an objective in our expanding and improving educational effort.

In keeping with increased public and professional acceptance, and probably as a result of the greater availability of opportunity for education, has been the effort in certain states to license specialists. A dental practitioner who *thinks* he wants to enter a special field is, in these states, automatically retarded from doing so even though his license to practice dentistry formerly permitted him to do so. Under these specialty licensing acts he must substantiate his added preparation and demonstrate his special practice qualifications before he can open office as a specialist. This arrangement may have been a premature effort, having been projected without proper preparation of the profession, and is not too well on its way to nationwide acceptance. Its weakness is not in its purpose or objective; it lies in enthusiasm getting beyond the limits of reasoning as has been the case in other procedures advocated toward solving some of our problems.

The continuous expansion in the educational effort resulting in a large growth in numbers has stimulated professional and public interest in orthodontics and raises the question as to whether we are upgrading qualitatively as well as quantitatively. The passage of time usually has the way of answering this question by sifting the weak and indicating the strong. However, some indication of what the situation may be is to be found in a consideration of what motivates the orthodontist toward his chosen field and what preparation he seeks in order to qualify for his special work.

Today, it is not unusual for a dental graduate to pass directly from his dental studies to the graduate study of orthodontics. He spends no time in general dental practice and except for *thinking* that he knows the field to which he wishes to devote his lifework he has no proof that he is suited for what he plans to do. In most states there is no regulation to keep him from trying to be a specialist, and if his dental school stressed orthodontics as he progressed through the basic sciences he will probably find that his foundation makes the transition not too difficult. If his ambitions have not outstripped his ability and his initial interest continues to mount, his decision to study orthodontics may have been a good one. Under such circumstances our specialty gains not only a new member but also one who will probably measure up as a qualified man. If, however, a student decides to take a stab at orthodontics because he sees nothing else in dental practice that interests him and, even in his undergraduate studies, saw fit to dodge as much orthodontics as possible, we find an individual who will lack the interest and vitality to carry on in the way we know he must, if he is to be a credit to our special field. It is possible, of course, that an individual student may develop in his graduate studies far beyond that which might, from previous attitudes, be expected of him, and other objection-

able motives may lessen as he learns more of the objectives and responsibilities of the orthodontist. Under suitable environment there is a chance that an indifferent boy who seeks to specialize or one who started with a distorted view may develop into something worth while. This places a grave responsibility on the graduate schools, indicating that, as they turn out graduates in number, they also control, by what they are able to do with their students, the qualitative aspect.

Because of this, after a good many years' teaching, I have come to the conclusion that orthodontics need not concern itself too much with the education of the *dental* student whose curriculum overflows under present-day requirements, but that we would do well to concentrate our support toward encouraging dental schools to provide necessary opportunities for graduate study in our special field. This is not an unreasonable attitude for the specialist must first be a dentist, and our dental educational standards are subject to rather strict controls. These controls have assisted in developing a curriculum in which each subject must be interrelated to the over-all educational pattern, and those who plan recognize the worth of each subject in the over-all picture. We hear complaints at times that orthodontics is subordinated and restricted, but we must remember that no matter how important we may think our work, the purpose of the educational effort is to bring forth a *dentist* and the curriculum is adjusted to that purpose by those who have spent their lives in the teaching field. It is probably true that phases of dental education have dominated somewhat to the exclusion of other phases, but we must admit that orthodontics has come a long way in the undergraduate field. I recall requesting a small area for orthodontic teaching and eventually getting it and seeing it expand into a unit comparable to any other department in our school. The level of effort is, and probably always will be, subject to improvement, but we are contributing in a sound and reasonable way to the education of the *dentist*. Our specialty responsibility is, and should be, to encourage the development and activities of the graduate school. Here we may inject ourselves with authority, insisting that as *specialists* (the same line of reasoning we grant the educator in relation to *dental* education) we know best what is needed and the sort of graduate that is wanted, and we can support our claims as to what will do the job. Our advice and assistance in this effort are logical and bear an imperative label. Encouragement of the dental educator to provide for increased graduate orthodontic facilities will start our second half-century with an objective that will aid in meeting the demands of the day. Since we have proved our ability to cope successfully with this major problem of our specialty field, such educational expansion ought not to be too serious an obstacle.

TREATMENT CONCEPTS

Success-Failure-Extraction.—A persistent weakness in our treatment concepts has been the absolute intent that every patient receive a "successful" treatment. No field of health service or possibly any form of human endeavor has been bedevilled more by that expression than has orthodontics. It came to mean that position and form must be perfect or what had been done was a

failure. Even though much evidence of beneficent effect could be seen, the job was considered a poor one if some natural adjustment occurred and a parent or dentist could point with dismay to a slight rotation or partial relapse as an indication that the orthodontist had not done too well. Exactness, preciseness became the definition of success. Common sense should have told us that such an attitude of mind was in conflict with nature's way of adjusting to the physiological and anatomical framework of the human being. Unfortunately, this attitude became a dominating part of the practice creed of a number of orthodontists, and their insecurity projected at our meetings and through our literature has confused and distressed competent practitioners whose sole purpose is to do well for their patients. A searching mind is a true measure of a profession, but along with it must go a breadth of understanding so that our thinking and visualizing will result in aids rather than hindrances and confusions to our efforts.

However, these self-criticisms, increasing in frequency and with greater emphasis, began to lay a groundwork with the specialty, the dental profession, and the public that we were a group unable to keep our promises. No one likes to have that said about him, and thinking members of the specialty realized that the complaint could not be allowed to go unchallenged. We would have been far more sensible had we kept this undermining of confidence attitude within our ranks until we knew, as a specialty, the whole story and how true it might be. The reason for the complaint had to be found. It has turned out to be more in our *thinking* than in our basic procedures. If we had not made outright promises as to what could be done for the patient, we had implied a degree of betterment which, in many instances, because of unrecognized conditions, could not be attained. Many of you will recall how implicitly from the beginning of the specialty we have been urged to follow the highway of perfection. For instance, months of effort and much appliance were needed to align and rotate slightly turned cuspids and incisors which esthetically and functionally were doing no harm, and the result obtained was, in the end, to provide nothing much better for the patient.

In seeking this idealistic state for human dentition we laid ourselves open to criticism. Speakers for the specialty of periodontia today claim that they are not too well pleased with esthetics assuming such an importance in orthodontic treatment objectives, and they believe that we would do better for the patient if we would emphasize functional improvement to some exclusion of our typically desired esthetic appearance. In the light of periodontic observations this is not an unreasonable request. But it cannot become possible until we convince the parent and the dentist that we are not beauty doctors and that we do not intend to allow ourselves to be placed in that position. A change in this direction is evident as a result of a more thorough understanding with the parent and the dentist as to orthodontic objectives. We are defining more clearly what can be done and what may be expected. One result is that we hear less complaints by parents of prospective patients that they hope the treatment their child will receive will be more "successful" than they had received. Not

infrequently such a parent is found to have a much better condition than she thought she had. But those parents, even as patients, never had a good understanding as to what result they might expect; hence the parents had always thought that the result ought to have been much better, perfection itself. The sensible orthodontist, for the good of everyone concerned, will have to see that parent, dentist, and patient understand the limitations of our work, and he will aim to provide useful and good-looking teeth without that exactness and perfection which parents had expected of their own treatment and had been disappointed not to receive. In other words, they must be impressed with the fact that sometimes if but half of a loaf is obtainable, it is better than no loaf at all. In doing this we do not imply approval of inadequate or incomplete efforts nor tolerate incompetence. We are simply indicating that there are physical disharmonies, inheritable, congenital and developmental malformations and deficiencies which are not fully remedial. The word "failure" which our perfectionist attitude made a part of our terminology and which has had such a profound influence on our remedial measures ought not be heard, therefore, so often. There will be no justification for the statement that if we look through a long consecutive list of our treated patients we will find it honeycombed with "failures."

That word has sour connotations. One definition of failure is "omission to perform." Are we really guilty of this? What are the circumstances under which this term applies to our work? Have we failed so much in our basic procedures or is it a *state of mind*, an illusion which has been permitted to grow professionally to support a treatment method which is widely used and which produces a result at variance with natural form and function? If we have "omitted to perform" to the extent that statements indicate, I am of the opinion that we have not done so technically or through basic procedure faults but more so because of our *thinking*. I reiterate that orthodontists seem unable or unwilling to admit that certain malocclusions might be incorrectable or only partially so. This, more than any other factor, I believe, accounts for what has been claimed to be a too high percentage of failures or lack of success in stable correction. Through our inability or unwillingness to state to anxious and insistent parents that orthodontics has not reached the stage wherein any request or desire can be met, we assume more than our share of the correction obligation. In other words, instead of developing an attitude of realism we verge on the egotistical with resultant mistakes in planning and execution; hence the groundwork for "failures" and the adoption of an expedient to offset them. We may find that the advocated treatment procedure to avoid this dilemma is not as advantageous as claimed, for the human equation still exists and seldom permits any field of endeavor, including correction of malocclusion assisted by tooth extraction, to do everything right all of the time. Or, to emphasize the point, extraction is no guarantee or insurance against "failure."

We live and practice under grave responsibilities for the welfare of our patients. We have unrestrained and unlimited opportunities for the exercise of judgment and we must control our thoughts so that whims and fancies do not

assume the place of well-considered action. We are not free to use our patients as a proving ground for ideas which may in final effect leave the patient with handicaps which are professionally created.

Extraction is nothing new.[2] Some of it was done by early orthodontists though attention was seldom called to it, and while a few orthodontists believed in it others acknowledged it only as a necessary evil. The terms "judicious" and "compromise" extraction were coined and when extraction was advised, it was carefully supported with a well-organized case history and based upon hard-earned experience in like cases so that many otherwise impossible conditions were benefited. The caution shown contrasts with today's procedure wherein many treatments have extraction advocated as a first premise. Judicious or compromise extraction was adopted by cautious and conservative practitioners as an aid in very difficult situations and not as an open-sesame to correction. The general practitioner was taken into the confidence of the orthodontist; the circumstances concerned with each patient were fully understood by all concerned. In doing this the orthodontist acknowledged that the general practitioner had an interest in his patient. We seem not to be as careful today to extend the same courtesies and unfortunately create at times the feeling that we own the patient. Today many dental practitioners are not too happy to find extraction advised without their knowledge or even accomplished as a part of their patient's treatment. They recall many satisfactorily treated cases without the patient losing a single tooth. They also recall the focal infection and tonsillectomy rampages and other sure-fire cure-alls which have turned out to be among life's embarrassing moments for the dentist and the physician. The public also thinks that professional people, hoping for a way out of confusion and frustration, are very likely to follow the leader, later finding themselves with loss of confidence to repay them for their lack of judgment. It may be that extraction as a fixed adjunct to practice will prove an exception but, as with other hurried and enthusiastic adoptions of treatment methods, complications arise. One which confronts us in this matter and from which there is no escape is:

"When we adopt extraction measures for the correction of malocclusion of the teeth we immediately change the type of malocclusion that we have had under consideration and must deal with a secondary malocclusion which we, by our extraction recommendation, have caused."

We have, then, the primary condition to correct and a synthetized one about which we actually have a greater responsibility because we contributed to its development. By our own devices and desires we assume to plan, because of the missing dental units, for an alignment of the teeth for the patient entirely different in anatomical form and relationship from that which is a natural result when all the teeth are present. In our result we create an arrangement of root position, coronal anatomical form, and occlusal stresses at variance with masticatory usage nature provides when the full complement of teeth are allowed to remain. The procedure is final in its effect; there is no recourse. It should, therefore, be very carefully and logically thought out, never hurried, never done as an expedient, excuse, or means to offset some of our so-called omissions

to perform. It should not be done because others do it or because it seems to be the easiest way. The procedure should be backed with unanswerable arguments. For, if through unfortunate circumstance, the public or the dental profession develops the idea that extraction has its faults, we, as individuals and as a specialty, will be in a precarious position. The dentist does not like to see his patient abused by hurried and ill-considered judgment, and many parents are disturbed when extraction is advised as an essential part of a proposed orthodontic treatment. In many instances they agree only under severe mental reservations and with misgivings.

Our problem then as orthodontists is to fit ourselves to distinguish the need for extraction as an adjunct to treatment and not to follow blindly along a trail that can lead to disappointment. We must school ourselves to have perception and depth of observation so that our decisions will be free of bias and from an unwarped judgment. The experienced practitioner knows that most activities lend themselves to errors and he will seldom accept, as one of lesser experience is likely to do, practice methods, without studying all the issues that compose the problem. He recognizes that this extraction controversy has brought into focus facts long known to persons of experience. One of these is that the human jaw, supposed to contain a certain number of teeth, does not in form and size always develop to that needed evenly and in good function to contain all the teeth. Because of this there are times when it is clear that the only way a good result can be had is to bring tooth material, through extraction, within the limits of the jaw. Under these circumstances there is no tendency to condemn extraction as an essential phase of orthodontic treatment methods but rather to make it clear we must know what we are doing in each and every recommendation. Thousands of good occlusions of fine appearance testify to our ability to work out our problems with the denture intact but no man of fair mind should hesitate in the best interests of his patient to advise extraction. This does not give us permission to run wild. The complications in each case must be understood, the decision reached only after all facts are known, and it should not be influenced by a childish enthusiastic follow-the-leader game or ill-advised action resulting from a narrow or selfish view of one's responsibilities.

Research, Diagnosis, Etiology.—Among the great words of language is research. Time may prove that no word in all its meanings has a more profound effect on what we do. It has transformed civilization and while in industry the effect is often in terms of human misery, in the professions of the health group, research has been essentially for the relief and elimination of distress.

Research usually develops a product before the full extent of its uses are known. Industry, for instance, provides a new alloy which, as such, is of little value until its uses are proved. Medicine looks through the microscope and finds an organism. The effect on mankind is seldom immediately known but the effect is as important as knowing that the organism exists. Orthodontic methods have developed in a somewhat similar way. The first decades were essentially a mechanistic era devoted to finding appliances that would move teeth, and the peculiar nature of "tooth straightening" requiring pressure from bands and

wires to activate tooth movement stimulated a continuous flow of new mechanical aids. They appeared so frequently and in so many forms that they created the impression that mechanics dominated orthodontic thought. Time was required to prove their use and many treated cases did not work out as anticipated. Even under most favorable technical conditions it became evident that hidden or elusive *natural* factors still persisted which mechanics did not demonstrate or eliminate. A spirit of criticism, born of disappointment, even became a bit acrimonious at times, as each technical advance raised new hopes that it would succeed as others failed to measure up to expectations and carried down to defeat remedial efforts. This great period of technological advance which produced appliances and proved their workability also demonstrated that there are physical conditions inherent to the patient which limit the use and effectiveness of the most efficient appliance. This knowledge of physical change now accepted as basic in orthodontic diagnosis and therapy had a very hazy beginning. As it passes through a clarification period it is not able as yet to answer many of our problems for, even with the assistance of most ingenious diagnostic aids, we are not much further advanced in factual knowledge concerning the causes of malocclusion than we were years ago. The reason for this is that these new diagnostic aids have merely substantiated the existence of the malformation and they tell us little or nothing as to the causes creating it. This is not to minimize the value of resultant growth studies nor the desirability of studying malocclusion possibilities even as early as the gum pad stage or the value of serial biological studies relating to comparisons of normal and abnormal jaw form and tooth displacement. But with all this information we have little knowledge of the actual factors which stimulated, maintained, or retarded the demonstrated growth variations.

Though history may record this era as the one of the "Biologic Concept," the meaning of the term as related to clinical practice was not well understood. The same error followed as occurred in the mechanical era. Enthusiasts were convinced that most of our problems were on the road toward being solved. As the biologic era advanced, practitioners who had become uncertain of themselves and their work hopefully accepted the doctrine, but the skeptical, many of whom had learned through difficult experiences, were not too sure that a panacea had been found. They are not as yet sure that the story is fully told. Time is showing that growth, development, and adaptability are splendid allies in corrective work and that they have a comparable, though not a more important, place in what we do than have mechanical aids. It has become apparent that the success of orthodontic treatment depends on a fusion of mechanical ideas and biologic concepts rather than overemphasis on either and that the patient does better when no one phase is dominant.

The biologic era came into being as a lusty child, and made just about as much noise with at times as little sense. Environment and what we called oral or local causes of malocclusion were pushed into the background and almost forgotten. Irregularities of the simplest form were considered to be a result of adverse growth and developmental factors. Orthodontists versed in technical matters but not well fitted by education to understand biologic complexities

began to wonder whether it could be true that there was a possibility that appliances might be materially lessened or dispensed with and the patient given a chance to "grow out of his malocclusion." Congenital malformations, hereditary and environmental factors made this eventuality hardly possible. One has but to look at the thousands of adults who have had the chance to grow out of their malocclusions without orthodontic help but have failed to do so to understand how true it is that this much-desired state is impossible of fulfillment. Nonorthodontists, by education fitted to analyze biologic problems but not to discuss technical problems, were impressive with their statements that the patient might be better with less therapy. We learned of basal bone and the apical base and the need for keeping within bone limits, and though arch expansion had been a long-standing tenet of treatment, less expansion became a factor in treatment. Early treatment was advocated to take advantage of natural long-term growth tendencies of the child, to encourage and support them through stimulation of retarded or slow growth. Fortunately, time has a way of working out many of these complications, and while procedures which seem to contradict each other create difficulties, they do serve a clarification purpose. One clear result of these activities has been that as we have heard more and more of the subject, we have come rather clearly to understand that there are limitations of growth and disharmonies of form which are inherent to the particular patient and that they continue in spite of all diagnostic and treatment efforts.

This understanding we may count as a very real achievement, and it may be attributed in part to the studies of the past twenty years which have outlined for us the patterns of natural cranial growth and the orientation of the denture in the skull. As a result we have, in all likelihood, been laying the foundation for a typing or classification of malocclusion which will not depend upon the teeth alone as most of the earlier classifications did. They assumed an important place in early orthodontics but clinical practice proved they did not disclose inhibitions to treatment which actually existed. We have, therefore, of late years come to look askance at our earlier classifications based upon "normal" occlusion of the teeth. Because of surface similarities in occlusal arrangement, we were led into believing that many malocclusions were much alike, and, therefore, subject to a classification based almost entirely on occlusal arrangement. The acceptance of that doctrine, while proved to be in error, simply represented a step in a natural selective process, wherein the profession by trial and error passed through a lot of rough water. Numerous classification efforts involving tooth location, anatomical landmarks, and facial form, outlined photographically and by the x-ray, have failed to provide a consistently successful working base. Diagnostic and therapeutic efforts uncovered classification weaknesses; there is today no useful formal classification and careful thought will indicate why the statement is true and why we may never have one. Malocclusions are as individual as the person so affected, and since no two persons are alike we probably never have two malocclusions alike though grossly they may appear so. Insight coupled with clinical experience day after day substantiates this statement. We may in the light of present knowledge be critical of these attempts to develop an orderly process for treatment needs, yet without

them much of our progress would have been further delayed. We learned from clinical observations that the position of the teeth is but a *symptomatic* part of the whole problem of malocclusion of the teeth, and that malocclusion is a manifestation in many instances of underlying disharmony which some years ago we did not know even existed. But these classification efforts represented a beginning and a lot of the better things of life as we know them have come from equally questionable foundations. Experience influenced us to change our ideas, practice has substantiated our findings, and much to the credit of the specialty we have been flexible enough to adjust to them with a minimum of conflict.

In a sense we have adjusted too readily. Due to the sheer weight of the biologic approach simple facts relating to malocclusion seldom are mentioned now though their ill effects are just as pronounced as they were years ago. In fact, etiology, to which in former years we attributed nearly 50 per cent of malocclusion, has been almost forgotten. Yet environmental influences are no less active even though biologic doctrines assumed an almost overpowering position in our etiologic thoughts. This attitude has created a weak link in our treatment chain and the point is well illustrated by recalling that fine physical specimens of manhood with marvelous skeletal growth and an optimum of development have gross irregularities of the teeth. By keeping this thought ever in our minds we will not be so likely to forget, as we have had a tendency to do, active etiological factors which have rather simple environmental or oral conditions as their source.

Why is it that with so much emphasis on growth and development we hear so little as to the effects of heredity? Inheritance is difficult to demonstrate as an active etiological factor in malocclusion, for the uninformed will often explain appearances resulting from obvious causes as being of genetic origin. I suppose it is because as a professional group we have not had the good fortune to have within our ranks persons trained in orthodontics who are versed in heredity. This may account in some measure for the lack of understanding and the neglect of the subject. Serious-minded students of malocclusion and its etiology have no proof that inheritance makes correction problematical or improvement questionable, yet they have little doubt that their successes will increase in proportion to their understanding of this obscure yet major problem of diagnosis. They find it difficult to believe that as the facial pattern evolves genetic factors are being denied. Cephalometry has not seemed as yet to offer much of practical value yet it may help to provide the answer to this uncertain problem of hereditary effect. Patients who are now having their growth patterns charted will eventually have children, who in their turn will have growth patterns charted, and comparisons that may be made may have value in diagnostic determinations. Parents, for instance, who offered correctional difficulties which could not be explained or relapses which occurred for no apparent reason might have shown chartings of growth disharmonies which in like manner show up in their child's chartings. If treatment is to be advised under these circumstances it undoubtedly would be provided under a protective measure of careful explanation and justifiable unassumed responsibility.

No discussion of our present orthodontic status and the changing field of diagnosis could be considered inclusive which did not speak of cephalometry. The use of serial head films, graphs, and charts to evaluate orthodontic treatment possibilities has been increasing in recent years. What it means, however, in terms of clinical practice or even everyday usefulness to the practitioner is difficult to say. Recently I read a letter which advertised a course in cephalometry which contained the following statements: "An *attempt* will be made to give a dynamic concept of cephalometrics," and "the possibility of predicting growth tendencies"; both statements seem to me to indicate a lack of sureness in what can be made of practical value out of the present status of the subject. Though the procedure has been available for a considerable period, the literature indicates that few are qualified to analyze its diagnostic depth or its treatment implications. The overbite problem, for instance, an occurrence which is ever present, would seem to be a fertile field for study for the original condition can be clinically and radiographically well defined. But the changes which result from the use of bands and wires as well as fixed and removable bite plates are not readily defined. We see clinically what happens but we are not able to explain as to how it comes about.

We can, though, with imagination, reconstruct our thinking to believe that the use of this adjunct (cephalometer) ought to help improve our diagnostic efforts. Yet there has been in our specialty development many disappointments and anticlimaxes in relation to strongly supported measures which time has proved of little value. Cephalometry has, obviously, some merit in the determination of our problems, but we have not translated, as yet, cephalometric studies into practical and beneficial corrective suggestions.

Our students of the subject have opened for the practitioner a new view of the unfolding of cranial growth in form and size, even as to the rate of growth, but they have not been able to answer sufficiently as to why the results shown by cephalometric charting should exist or project measures which would favorably alter the abnormal condition. The situation is somewhat analogous to the cancer problem. The lesion is clinically and radiographically known, its rate of growth, size, and form are watched, and there is no doubt that the patient is proved to be the unfortunate possessor of an unwanted condition. But, when it began, what initiated it or influenced its continuation are still, in the main, unknown. Neither does the diagnostic evidence indicate that some form of interference or help might have been given during the earliest stages which might have lessened or eliminated the malignancy. The scourge exists but prevention is still nebulous, and the cure, though medical science has worked wonders, is frequently on an empirical basis. So it is with malocclusion of the teeth. In spite of still limited diagnostic ability we have been able to produce some amazing changes, wherein structural disharmonies involving face, jaws, and dental arches are restored to varying degrees of normalcy. However, many of the corrections are from the group which had their onset as a result of environmental conditions rather than from histological, physiological, or pathological factors. That they are amenable to treatment is because the etiology is recognized and understood and therefore may be sufficiently controlled or eliminated.

The more serious group of malocclusions, in which growth and development and adaptability are altered by nutrition, disease, genetic factors, and glandular disorders influencing cellular growth, provide the cases where the inhibitions to normalcy are still obscure and we still treat them very much in the dark. Cephalometry may be a ray of light for the coming decades and may be the field from which will come the help we so definitely need. If it does not it will certainly not be the fault of those who have worked and are now working so strenuously to make the procedure a useful adjunct to the field of clinical practice.

PROFESSIONAL RELATIONSHIPS

The orthodontic specialty is large in numbers. Size indicates demand and demand denotes acceptance by the profession which advises and by the public which seeks advice. It does not assure continued acceptance unless service succeeds in fulfilling expectation. The dental profession turns to the specialty for a needed service and the task of the specialty is to work with the profession in an agreeable and beneficial way. The specialty has a real obligation to be a part of the profession and not withdraw into a shell wherein it creates a feeling it is superior to, or above listening to, the complaints and faults the profession thinks or knows exist. On several occasions in recent months I have heard it said that we are the cream of the profession, that we represent the best in the profession. It was said in November in New York and in April in Louisville. These are unwise and irritating statements and ought not to be made publicly even if the speaker believes what he says. The specialty has been most aggressive in achieving a position of real importance through education, research, organization, and practice control, and we have been most liberal in our scientific program and literary contributions. But the dental profession has also made great strides and no belittlement of that effort should be implied by the smug satisfaction which is indicated by our tacit approval that we are tops. That is not the way to develop friendship or maintain the good will of our professional associates, for, while in the natural course of competitive events there must always be one out in front, he is not well-thought-of if he makes his abilities too well known by blowing his own horn. It is much to be preferred that we be grateful for the favored position that we have reached and join our efforts with others to make a better status for all. There is no exception to this in our professional field.

A splendid example of cooperative effort and good will, as well as unity of purpose, is the recent solution which untangled a serious confusion of ideas which had developed between the Council on Dental Education of the American Dental Association and the American Board of Orthodontics. I will not go into detail regarding the Board, its organization, the number who by examination have qualified, or the need the Board serves, but we have in this Board, created by our official society, an example as to how the profession can control its own efforts and supervise quality of service without having nonprofessional interests dictate to the profession. The American Board of Orthodontics was the first dental specialty board and it was not long before other specialties followed. These new boards, in process of forming at the time when the Council on

Dental Education began to show interest in specialty boards, were able to organize in keeping with standards which the Council advocated, but those standards were at variance with what the Orthodontic Board had developed and successfully worked under. The main conflict revolved around time requirements for orthodontic graduate instruction and with opportunities for Board approval which had been extended Canadian orthodontists. It was essential that the conflict end so that the American Board of Orthodontics might have the approval and official sanction of the governing body of American dental education. The Board and the Council sat down through assigned committees, and without quarrels and animosities gave a real meaning to the spirit of professional cooperation, even though the lengthening of the graduate courses has affected the presently organized graduate school in a manner which requires considerable adjustment to meet the ideas of the Council on Dental Education. Contrast this to the personality, technical, therapeutic, and practice difficulties of bygone days when narrowness of vision exercised a crippling effect on progress and years had to pass before knowledge gained from scientific discussion, experience, and usage permitted a professionally friendly settlement of controversial issues. The spirit of cooperation that has developed within the profession is an outstanding achievement.

During the past five decades the orthodontic specialty service has been a most active and creditable factor in the betterment of human dentition, and through it the health and happiness of the individual. Our societies, our literature, our schools and individuals give no indication that they will rest on these laurels, but no relaxation of effort should be condoned. We must not compromise with principles nor follow blindly large-scale popular ideas which may have dangerous consequences. We must learn to demand proof of the soundness and worth of treatment measures. If we assume our responsibilities which have been on the increase as the decades have passed we shall be a credit to the professional world, an indispensable part of the public's need, and justify our existence in the realm of health service. Ours is not a sterile field, past progress has not exhausted our abilities, the years have simply proved what they are. No excuses need to be offered for the extent or rate of our progress, and with reasonable assurance we can feel that our second half-century will repay us manyfold for the physical and mental investment of the first half. However, we will progress more rapidly and with greater accomplishments if we control our presumptions and even our optimisms so that they do not misdirect otherwise intelligent effort.

I am very happy to have been a part of the specialty during this formative and constructive period, and I hope that you are better than well satisfied that you have been.

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NEW HORIZONS IN CASE ANALYSIS—CLINICAL CEPHALOMETRICS

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> And they said to one another: Go to, let us build an institution, a tower, and let us establish ourselves and make us a name, lest we be scattered upon the face of the earth. And it came to pass that the people prospered and the structure grew, and the workers became as numerous as the grass of the field.
>
> But behold, there rose up specialists; some there were who were ORTHODONTISTS, some PROSTHODONTISTS, some EXODONTISTS; others there were who were HISTOLOGISTS, RADIOLOGISTS, PEDODONTISTS, and PERIODONTISTS. Then did each group cleave unto itself and forsake the others, and the work on the tower did begin to suffer.
>
> And lo, confusion grew and multiplied throughout the land. Then arose a cry from the workers: let ivory be brought for the completion of the tower. And it came to pass that the specialists did multiply and did form themselves into lesser groups of specialized specialists until all progress ceased, for there was a strange confounding of language and they understood not one another's speech.
>
> Then were the dentists without unity; then did their common heritage slip from them, and they became scattered like leaves over the face of the earth.
>
> And the tower fell into ruin and decay. Therefore is the name of it called Babel, because the speech of the people had become as divers strange tongues and as the clashing of cymbals.[1]

THIS parody of a rather well-known passage is not without significance to the practicing orthodontist. To many, the dichotomy of appliance controversy and case treatment finds ultimate expression in cephalometrics, for to them, cephalometrics is synonymous with Babel.

There is some justification for the welter of conflicting opinions and misconceptions belaboring cephalometric analysis today. When a new approach is developed simultaneously by independent workers in the field, especially when dealing with physiologic media, it is inevitable that differences of emphasis and opinion will crop out. This was witnessed just twenty-five years ago, when gnathostatics was in its heyday. Inquiring clinicians at that time were searching for the very same information we look to cephalometrics for today. It is a tribute to them that the results of their efforts served as a basis for modern case analysis by means of radiographic diagnosis. Nevertheless, those pioneers were constantly badgered and hamstrung by confreres ignorant of the implications of skeletal pattern in orthodontics. Gnathostatics was finally crucified because of procedural difficulties and errors in interpretation which any new technique must face—and eliminate through use. If we learn by our mistakes, this

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offering of gnathostatics on the sacrificial block to satisfy selfish motives and to exploit individual antipathies will not happen to cephalometrics. However, it is high time that a few misconceptions be exploded.

1. Radiographic cephalometrics is not tied to any particular appliance—there is no connection at all. While much of its development was under the aegis of those working incidentally with one appliance philosophy, the information it offers transcends appliance-made barriers.

2. There is nothing mysterious about it—its terminology, its armamentarium, its application.

3. It does not require a font of specialized wisdom, based deeply in anatomical minutiae and physiologic manifestations, and understood only by those so grounded.

4. It does not require expensive research-type equipment. It can be adapted to an ordinary dental x-ray machine at target-film distances of 3 to 3½ feet, using an inexpensive orienter that will provide all the necessary information, and double as a head holder for taking patient photographs.

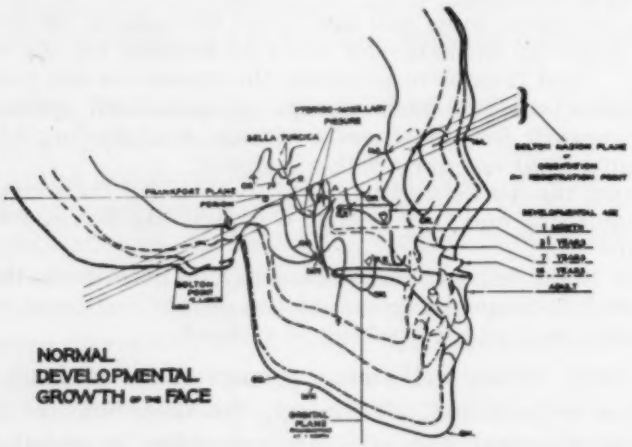

Fig. 1.—Normal developmental growth of the face from the Bolton Study records. *A*, Angle of Frankfort plane of the first record to the Bolton-nasion plane of orientation; *GN*, gnathion; *GO*, gonion; *KR*, key ridge; *NA*, nasion; *OR*, orbitale; *OS*, occipitosphenoidal suture; *MN*, mandibular notch. Broadbent growth series. Serial tracings from infancy to adulthood.

5. It is not an arduous, time-consuming task, but a process that can be completed in the time it takes for a set of impressions—and not chair time at that!

6. It is not a panacea for all case analysis ills. It is not a substitute for plaster casts, dental radiographs, photographs, and, most of all, examination of the patient. It does extract more information from each of these diagnostic criteria and correlates this information, but by itself it is totally inadequate. It is not essential to good orthodontics, and many men using it are not necessarily placed in that category, either.

On the positive side, used properly, radiographic cephalometrics can give information on many aspects of orthodontics.

Growth and Developmental Appraisal.—This phase has been explored most completely by numerous investigators in the field, following the initial work of

Broadbent[2] in 1931. We have only to refer to the work done in the orthodontic departments of Northwestern University and Illinois for many detailed and complete analyses of the dynamic processes of craniofacial growth. It is not the purpose of this paper to examine this material. One implication of clinical significance can be drawn at this time, however. Growth, once lost, cannot be regained, so that if we are confronted with a patient with an obvious mandibular deficiency, it is a forlorn hope to expect restoration of normal form and relationships by orthodontics, or any other means presently available. No chins are grown today (Fig. 1).

Fig. 2.—Lateral headplate, showing egg-shaped tonsillar mass in nasopharynx, and partial epipharyngeal obstruction by excessive adenoid tissue.

Fig. 3.—Clinically excellent occlusion. Forward divergent face on left, backward divergent face on right.

Abnormalities.—Most departures from the normal are evident in dental radiographs. With the increasing number of patients being referred to x-ray laboratories which operate on a competitive fee basis, the quality of pictures has sometimes suffered, and the information may be obscured by technical deficiencies. The oriented lateral headplate is an excellent check on dental radiographs, not only for what they may miss, but for areas that are beyond their scope. In addition to picking up impactions, congenital absence of teeth and supernumerary teeth, the headplate, by virtue of the constant direction of the central ray, perpendicular to the mid-sagittal plane, gives a truer picture of the inclination of unerupted teeth and the space available for these teeth in the dental

arch. Tonsillar and adenoidal tissue is shown in profile (Fig. 2). The limitations of less frequent conditions such as macroglossia, birth injuries, cleft palate, and mandibular prognathism are readily apparent.

General Facial and Skeletal Type.—We have only to look at Fig. 3, a photograph of two patients, both with clinically excellent occlusions, to realize that the forward or backward divergence of the face affects the position of the teeth in relation to each other and to the basal bone. Photographs are helpful in this regard, but frequently the soft tissue effectively masks skeletal contours that show up in the lateral headplate. This point will be discussed more in detail later on.

Fig. 4.—Left, widely held concept of relation of jaws at birth. (After Brash.) Right, relation of jaws invariably revealed by x-rays. There is protrusion of the tongue between the arches. (From Thompson and Brodie.)

Functional Analysis.—The initial impetus to this concept was given by Brodie,[3] when he pointed out that an infant is born, not with his gum pads clamped together as has been shown in so many anatomy texts, but with the jaws apart, the mandible suspended by facial, masticatory, and skeletal muscles (Fig. 4). By means of cephalometric studies, Thompson elaborated on this thesis and demonstrated that the physiologic rest position of the mandible was the most stable relationship throughout life, least affected by growth disturbances and environmental influences. This positioning of the mandible by the supporting musculature is made possible by the maintenance of a predeterminable resting length of component muscle fibers under tonal contraction. Thompson thus demonstrated that occlusal relationships, i.e., with the plaster casts related in occlusion, were frequently not true records of skeletal and dental dysplasia, and that these occlusal relationships often provided an apparent malocclusion that was of entirely different proportions when seen with the mandible at physiologic rest.[6] Occlusal aberrations are reflected in varying interocclusal clearances, emphasizing the three-dimensionality of the orthodontic problem. The vertical discrepancies in malocclusions are seldom due to derangement of muscular positioning of the mandible; almost always they are attributable to basal or alveolar bone dysplasia, or lack of eruption of the teeth themselves. Such dysplasias lead to functional problems, as illustrated by Figs. 5 and 6. Without lateral headplates, functional problems are easily missed.

Cephalometrics Used as a Diagnostic Criterion.—The use of radiographic cephalometrics as an aid in orthodontic diagnosis is perhaps the greatest contribution, but it has had a sobering influence on the profession as a whole, by

pointing up our limitations in therapy. Considerable criticism has been heaped upon cephalometrics, either by those who did not understand it, or by agnostics who scoffed at the audacity of anyone trying to measure physiologic phenomena. There is some basis for the latter. The path of cephalometrics has been a devious one, with much too much emphasis on so-called norms, from groups too small

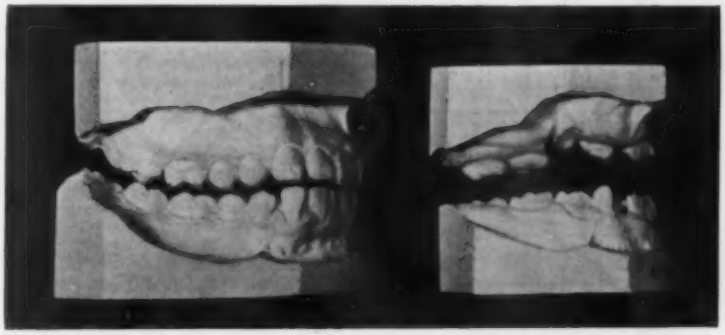

Fig. 5.—Normal and abnormal interocclusal clearance. Deficient maxillary growth associated with a cleft palate deformity accounts for the excessive interocclusal clearance in the casts on the right.

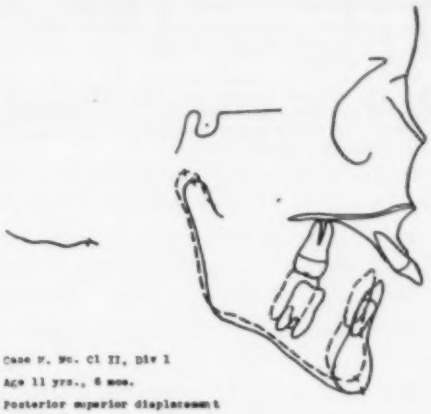

Fig. 6.—Tracings of rest and occlusion headplates superimposed, demonstrating abnormal backward and upward movement of the condyle in the fossa, i.e., a mandibular displacement (Thompson).

to be statistically significant. The earlier workers stressed individual measurements too much. For example, the lower incisor was supposed to have an axial inclination of approximately 90°, when compared to the mandibular plane, a line drawn tangent to the lower border of the mandible. If a malocclusion presented with an inclination of 98°, the lower incisors were considered procumbent, and this was considered by many clinicians as ample reason for extraction of first premolar teeth. We now realize the folly of this approach, for 90°, 92°, 95°, or 99° can be normal for a particular individual, depending on the relationship of the teeth to basal bones, the basal bone relationships to one another, and the relationship of maxillary and mandibular basal bones to the cranial base. In other words, no single criterion means much by itself. Only when it is correlated with other criteria assessing the same or associated struc-

tures can valid conclusions be drawn. We have learned by our mistakes. The study of treated cases emphasizes the importance of correlation of measurements *within the same individual.*

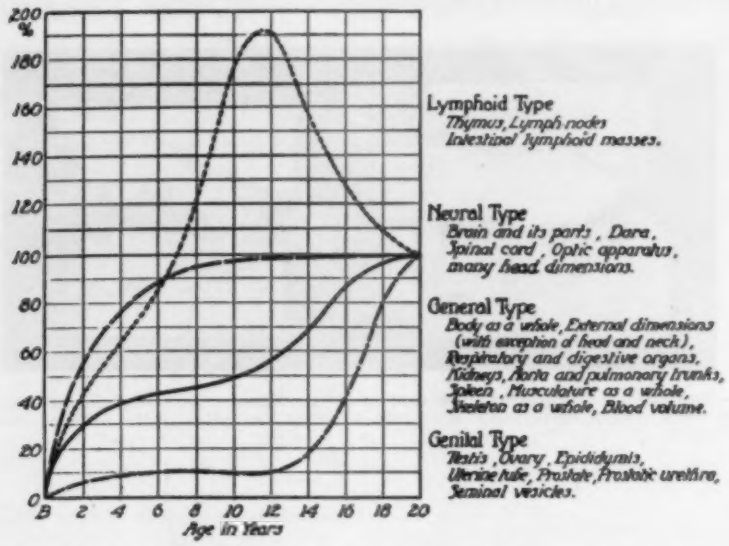

Fig. 7.—A graph showing the major types of postnatal growth of the various parts and organs of the body. The several curves are drawn to a common scale by computing their values at successive ages in terms of their total postnatal increments (to twenty years). Differential growth rates of body tissues (Scammon).

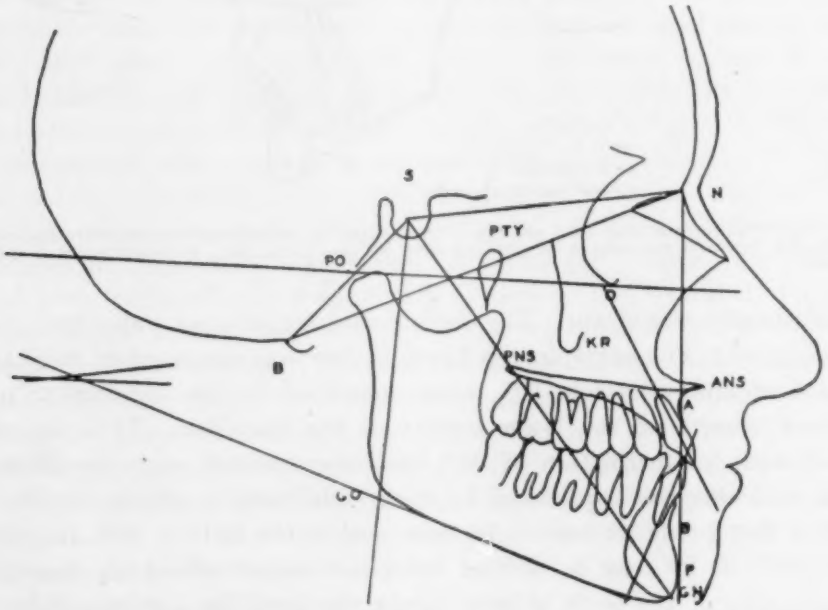

Fig. 8.—Planes and landmarks. *S*, sella turcica; *N*, nasion; *PTY*, pterygomaxillary fissure; *PO*, porion (machine registration); *O*, orbitale; *KR*, key ridge or zygomatic buttress; *PNS*, posterior nasal spine; *ANS*, anterior nasal spine; *B*, Bolton point; *A*, subspinale; *B*, supramentale; *Go*, gonion; *Gn*, gnathion; *P*, pogonion. Cranial base planes are *S-N* and *PO-O* (Frankfort horizontal).

Cephalometric analysis is based on the differential attainment of the developmental pattern by the various components of the cranial and facial bony skeleton. As has been pointed out by Scammon,[4] and elaborated upon by Krogman,[5] the cranial pattern follows the neural curve of growth (Fig. 7). This curve is precipitate at first, leveling out after the first five years into a gentle and constantly climbing arc. At five years, the cranial portion is about 85 per cent complete. Not so the facial portion, however. While different parts of the facial skeleton grow at different rates (i.e., maxillary width versus maxillary height), the over-all growth rate of the facial complex patterns what Scammon called the general growth curve, where attainment of ultimate size and shape is more gradual and is accomplished over a longer period of time. Cephalometries makes use of the differential rate of growth by using the cranial component as a base from which facial and dental relationships can be interpreted. There is, of course, some change in the cranial base during the time the orthodontist ordinarily will observe the patient, but this change is relatively small when compared to the facial and dental changes. This is especially true if the method of appraisal is based on angular and not linear components. Certain anthropometric and cephalometric measure points have been selected in an attempt to develop a constant, easily definable, and accurate set of criteria (Fig. 8).

Nasion.—The frontonasal suture, or junction of the frontal and nasal bones. This is seen in profile as an irregular notch. The nasal bone is considerably less dense radiographically than the frontal bone, making it relatively easy to follow the suture, even when the notch is not apparent.

Sella Turcica.—The center of the bony crypt occupied by the hypophysis cerebri. Radiographically, a very constant profile outline seen in its lateral aspect.

Porion.—For this study, this is a machine registration of the center of the external auditory meatus, not necessarily corresponding to the anthropometric landmark in the skull proper, but nevertheless constant.

Orbitale.—The lowest point on the inferior bony margin of the orbit, usually as viewed in the lateral headplate.

Gnathion.—The most outward and everted point on the profile curvature of the symphysis of the mandible.

Pogonion.—The most anterior point on the symphysis of the mandible.

Gonion.—The most outward and everted point on the angle formed by the junction of the ramus and body of the mandible on its posteroinferior aspect.

Anterior Nasal Spine.—The spinous process of the maxilla forming the most anterior projection of the floor of the nasal cavity.

Posterior Nasal Spine.—The spinous process formed by the most posterior projection of the juncture of the palatine bones in the midline of the roof of the oral cavity.

Pterygomaxillary Fissure.—An oval-looped radiolucency resulting from the fissure between the anterior margin of the pterygoid process of the sphenoid bone and the profile outline of the posterior surface of the maxilla.

Bolton Point.—The juncture of the outer plate of the occipital bone with the posterior margin of the occipital condyles. The condyles bound the foramen magnum laterally, and the established measure point approximates the center of the foramen magnum, anteroposteriorly, when viewed in the lateral oriented headplate.

Point A. (Subspinale).—An arbitrary measure point taken at the innermost curvature from the maxillary anterior nasal spine to the crest of the maxillary alveolar process, signify-

ing the approximate juncture of the basal or supporting maxillary bone and the alveolar bone (apical base). This point on the anterior profile outline of the maxilla is seen in lateral headplates.

Point B. (Supramentale).—An arbitrary measure point on the anterior profile curvature from the mandibular anthropometric landmark *pogonion* to the crest of the alveolar process. This most posterior point usually falls just anterior to the apices of the incisor teeth and, like *Point A* in the maxilla, divides basal and alveolar bone (apical base).

The sella-nasion plane as a cranial base has been selected, not because it is more accurate, or in any way superior in interpretation to the Broadbent-Bolton or the Frankfort horizontal plane, but because the terminal points are always easily picked up from the radiograph. Bolton point, which is the posterior terminus of the Bolton plane, is somewhat obscured by the downward proliferating mastoid process in the teen-age youngster. Both orbitale and porion, terminal points of the Frankfort plane, show considerable variation, and at times appeal somewhat to the average operator's imagination in the process of tracing.*

For the purpose of our cephalometric analysis, malocclusions can be divided into three groups:

1. Skeletal dysplasias—malrelationship of the maxillary and mandibular bases, with the teeth reflecting this malrelation, but perhaps in fairly good position when compared to their basal bone alone.

2. Dental dysplasias—good skeletal pattern, but with the malocclusion manifest only in the tooth areas.

3. Skeleto-dental dysplasias—combination of basal and local malrelationships to varying degrees.

It is rather difficult at times to classify many cases in their proper category merely by studying the models. Yet the prognosis of treatment, regardless of the appliance used, depends heavily on the category. In the radiographic cephalometric analysis, two major divisions have been set up to help classify the malocclusion. As with any arbitrary division of criteria, there is some overlapping, but the resultant simplification makes the diagnosis easier.

1. *Skeletal Analysis.*—Whether we can influence facial type, basal bones, malrelationship of parts or not—and there is considerable evidence to show that we cannot—certainly the basal bone relationship influences what we can do. In convex, backward divergent profiles, the teeth assume a different relation to basal bone than in the forward divergent (Hollywood) or concave profile. What is normal for one is certainly not normal for the other. In the interest of simplicity and practicality, the skeletal analysis can be reduced to three elements and still provide the necessary information.

a. *Angle of facial convexity (N-A-P):* As has been intimated already, the type of facial profile influences the angular relation of the teeth. A convex, backward divergent face will tolerate, will demand, a greater degree of procumbency than a concave or forward divergent face. A high degree of con-

*Because of the broad scope of this paper, and the limits of space, it is not possible to describe the technique of tracing cephalometric radiographs. However, mimeographed material on this phase of cephalometrics will be sent on request.

vexity may reflect a forward positioning of the maxilla or retrusion of the mandible, but this conclusion cannot be drawn from the angle of convexity alone, but depends on the individual relations of the maxillary and mandibular bases to each other and to the relatively constant cranial base.

b. *Apical base relationship:* There are several ways of arriving at this information. The technique described is the one used at Northwestern University, and as with the choice of a cranial base, makes no claim of superiority. In our hands it has proved simple and the most practical method and would seem to be at least as accurate as the several other means of apical base appraisal. The lateral headplate is taken with the teeth in occlusion, and the landmarks traced. The angles S-N-A and S-N-B are measured with a protractor

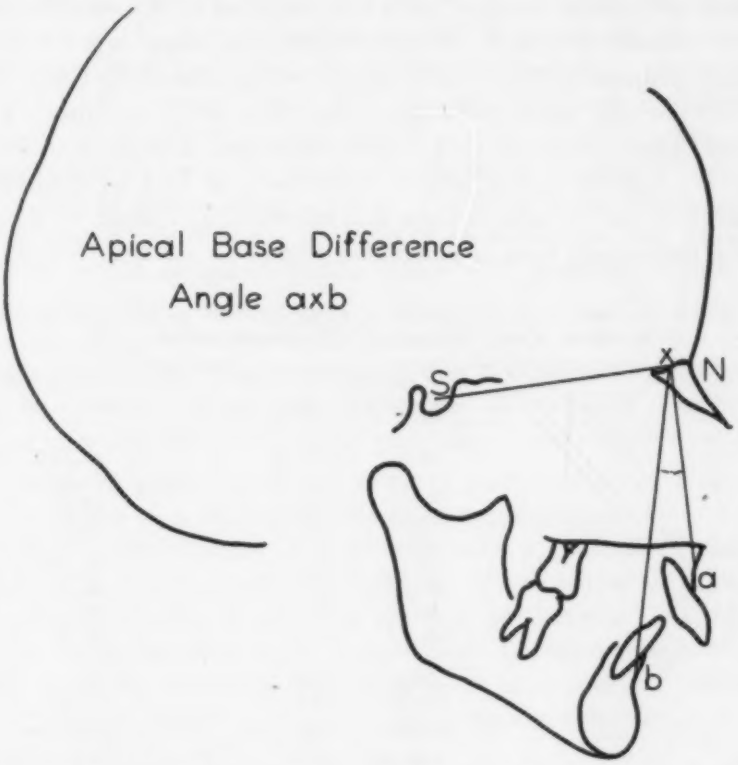

Fig. 9.—Diagram of Freeman-Rasmusson method of relating maxillary and mandibular apical bases.

and the difference between them determined. This represents the anteroposterior apical base relationship. If the individual S-N-A and S-N-B angles are compared to the standards set up for these criteria in so-called clinically excellent occlusions[6] (Table I), some idea of their individual pattern attainment may be gained. This is subject to the limitations of all attempts at setting up "norms" for human material, and rightly gives only an indication of the general tendency. More important is the relationship of the parts *within the same individual.* A simpler means of apical base appraisal, taking into account the varying divergencies of facial type, has been developed by Freeman[6] and Rasmusson[7] at

Northwestern University (Fig. 9). Point A is established, and a perpendicular to the SN plane erected. A line from the point of intersection of the perpendicular to the SN plane is then drawn to Point B on the mandible (on the lateral headplate with the teeth in occlusion) giving an angle which varies with the anteroposterior positioning of the maxilla and mandible.

c. *Inclination of the mandibular plane (N-S—GoGn):* The mandibular plane angle has long been used as a diagnostic criterion by clinical orthodontists. While, in the light of a full cephalometric analysis it assumes less importance, and while, by itself, it may frequently be misleading, the mandibular plane inclination still provides valuable information. A high apical base difference often goes with a steep mandibular plane. A steep mandibular plane frequently finds compensatory dental changes, with overeruption of the mandibular anterior segment, and excessive overbite. A steep mandibular plane is a severe limitation on holding any changes in the occlusal plane (accomplished by Class II therapy) or in maintaining any permanent correction of a deep overbite. This should be recognized before treatment. To some observers, a steep mandibular plane is indicative of lack of ramus height, specifically of lack of condylar growth. We are unable as yet to substantiate this contention; indeed to do other than recognize the limitations such a morphology imposes on our therapy.

TABLE I. MEAN AND STANDARD DEVIATION VALUES DERIVED IN STUDIES OF ADULTS AND CHILDREN WITH CLINICALLY EXCELLENT OCCLUSIONS

	ADULTS		CHILDREN	
	MEAN	ST. DEV.	MEAN	ST. DEV.
Skeletal:				
N-a-P	+1.62°	4.78°+	4.22°	5.38°
NP-ab			−4.6	3.67
S-N-a	82.01	3.89	80.79	3.85
S-N-b	79.97	3.60	78.02	3.06
Diff.	2.04		2.77	
NS-Go-Gn	31.71	5.19	32.27	4.67
FH-NP	88.56	3.17	85.33	2.42
ManPL-FH	26.15	5.95	27.06	4.67
SGn-FH	60.68	3.48	60.58	2.89
Denture:				
S-N-Gn	79.29	3.39	76.93	3.02
$\lvert\underline{1}$ – NS	103.97	5.75	103.54	5.02
$\lvert\underline{1}$ – $\lvert\underline{1}$	130.98	9.24	130.40	7.34
$\lvert\underline{1}$ – GoGn	93.096	6.78	93.52	5.78
$\lvert\underline{1}$ – OP	69.37	6.43	71.79	5.16
ab – OP	91.28	3.46	92.08	3.64
$\lvert\underline{1}$– NP (mm)	5.51	3.15	6.35	2.67

2. *Denture Analysis.*—This is the part we can influence.

a. *Upper incisor axial inclination (to the NS plane):* This can be seen from the cast, but how is the cast mounted in the face? Gnathostatics gave us this information, though not quite as accurately, since it depended on an externally determined cranial base (Frankfort plane), was masked by soft tissue, and was somewhat variable. A rather precise value of the relationship of the upper central incisor to the NS plane is readily determined. For interpretation, refer-

ence may be made to the table of values for clinically excellent occlusion (Table I), but here, again, more important, is the type of face, apical base relationship, and inclinations of teeth *within the same individual.*

b. *Lower incisor to mandibular basal bone (axial inclination to NS-GoGn):* As Table I shows, there is a broad range and large standard deviation in so-called normal studies. The 90° value is a misleading criterion, lumping together extremes in skeletal variation. It is imperative that interpretation of the angular relationship of the mandibular incisor be conditioned by the skeletal analysis, specifically by the apical base relationship and inclination of the mandibular plane. Furthermore, normal or so-called normal inclination of the mandibular incisor to its base means little, if that base is malpositioned or dysplastic itself.

c. *Relation of incisors to the occlusal plane:* This is one of the more important criteria of the denture analysis group. Statistically, the standard deviation in studies of so-called clinically excellent occlusions is one of the smallest. (See Table I.) It has been stated that the occlusal plane inclination is partly dependent on the mandibular plane angle. In so-called normals, the occlusal plane roughly bisects an angle formed by the maxillary and mandibular planes. In severe Class II malocclusions, where the mandibular plane value is quite high, the occlusal plane does not open up correspondingly, but maintains a relationship closer to the maxillary plane. Thus with a smaller standard deviation in the mean values for "normals," the angular value for the mandibular incisor to the occlusal plane is more reliable than the inclination of the lower incisors to the mandibular plane. The inference is that the inclination of the mandibular incisor is more closely correlated to the line of occlusion, established by the dynamics of muscular forces—by function—than to mandibular morphology.

d. *Relation of upper and lower incisors (intersection of long axes):* This is not too important as a diagnostic criterion, inasmuch as there is a broad range in the so-called normal studies. The inclination of the maxillary and mandibular central incisors is directly under the influence of the orthodontist, however, and a decided change can be observed as a result of therapy. As with the other local criteria, the ultimate value is dependent on the skeletal appraisal. A large apical base dysplasia makes it impossible to treat a case to "normal" values. A backward divergence of facial profile will require different axial inclinations from a forward divergence.

e. *Relation of the maxillary incisor to the facial (N-P) Plane:* This is a linear measurement taken from the incisal tip, perpendicular to the facial or N-P plane. The information gained, qualified by the skeletal analysis, further aids in classifying the malocclusion (skeletal, dental, or skeletodental). While it is very difficult to change the relative positions of Points A and B, signifying the apical base of the maxilla and mandible, the upper incisor position can be changed easily. Considering the facial profile, the degree of maxillary incisor protrusion is rather important from the esthetic and patient satisfaction aspects.

The best way to illustrate the value of cephalometrics is to demonstrate its practical application. Class II malocclusions make up a large part of the average orthodontist's practice. We have been led to believe by proponents of vari-

ous appliances that they all treat out using pretty much the same appliance and following a set procedural pattern. Therapeutic success depends on the degree of faithful adherence to the use of the recommended technique. *This is not true.* There is a lot of difference in Class II malocclusions, though not in the cases shown at professional meetings to demonstrate therapeutic success. These are predominantly dental malocclusions, skeletodental problems, or functional retrusions. The tough, skeletal problems remain on the shelf. Of course, the skeletal or dental basis of the malocclusion is not apparent from the casts,

Fig. 10.—Plaster casts of three Class II, Division 1 (Angle) malocclusions. The tooth malrelationship is similar, the skeletal pattern and treatment prognosis quite different.

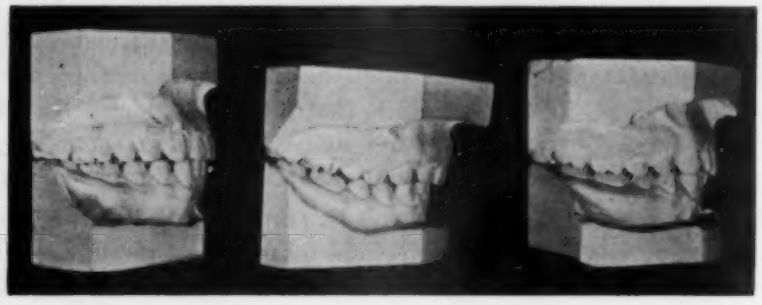

Fig. 11.—The treated results of the cases in Fig. 10. Even the casts show the difference in axial inclination of incisor teeth required to bring them into functional contact.

which may look exactly the same, and usually do. The common denominator for success is not any one appliance or its superior manipulation. Rather it is the inherent skeletal and dental patterns. Any one of several appliances may end up with an excellent result in Class II malocclusions where the disturbance is primarily local, or dental. All appliances and techniques are subject to the same severe limitations imposed by skeletal dysplasias. The degree of success is not dependent on the number of bands, the type of attachment, the length of time in treatment, so much as initial dentofacial morphology and developmental pattern. Figs. 10 and 11 show three Class II, Division I cases, all with the same relative degree of tooth malposition, overbite and overjet. They look the same from the casts. Should they be treated the same? The answer is not found solely in analyzing the casts. Photographs prove to be of some assistance, showing relatively good facial balance in Cases 1 and 3, poor balance in Case 2 (Figs. 12, 13, and 14). Cephalometric radiographs tell us much more (Fig. 15). An analysis of the path of closure from physiologic rest position to full occlusion

shows a postero superior mandibular displacement in Case 1, and normal paths of closure in Cases 2 and 3. In the first case the apical base difference of 7° is excessive, but at least 2° of this value may be attributed to the displacement, and the severity of the malrelationship is apparent rather than real, seen with the teeth in occlusion on the plaster casts. Case 2 has a marked apical base

Fig. 12.—F. H., Class II, Division 1 malocclusion, good facial balance. Her casts are the first on the left in Figs. 10 and 11.

Fig. 13.—J. N., Class II, Division 1 malocclusion, good facial balance. The center casts in Figs. 10 and 11 belong to this patient.

Fig. 14.—W. L., Class II, Division 1 malocclusion, poor facial balance. The casts on the right in Figs. 10 and 11 belong to this patient.

dysplasia (9°) and Case 3 shows a low AB difference of 3°. Can we expect these cases to treat out similarly, since they resemble each other as far as tooth position and arch configuration are concerned? We cannot. The prognosis, time in treatment, and therapeutic aims must be different. In Case 1, a Sved type bite plate was worn for three months, eliminating the functional displacement. A headplate at that time showed a reduction of 2½° in the AB difference,

and a 50 per cent correction in the Class II molar relationship. Remaining treatment was accomplished with conventional appliances and a minimum number of teeth banded. Terminal headplates show a normal path of closure, an apical base difference of 4°, the upper incisors tipped lingually 7°, the lower incisors tipped labially 2° into a correct relationship (Fig. 16). In Case 2, regardless of the appliances used, the high apical base disharmony will not permit establishment of normal axial inclination of the incisor teeth to each other or to the basal bones. Fig. 15 shows that the tooth to basal bone relationship in Case 2 does not differ radically from the values for Case 1, but the apical base difference is the determining factor in the final result. Two years of full treatment with full edgewise appliances augmented by occipital anchorage failed to produce a harmonious dental result. To bring the upper and lower incisors into occlusion, the maxillary teeth were tipped excessively lingually 25° to an all too upright 88°. Even this severe overtreatment would not have been enough for incisal function, had not the mandibular incisors been tipped 13° into a 106° procumbency (Fig. 16). Is the end result stable? Probably not, and this should be recognized at the beginning of treatment rather than excused or apologized for on the completion of appliance therapy.

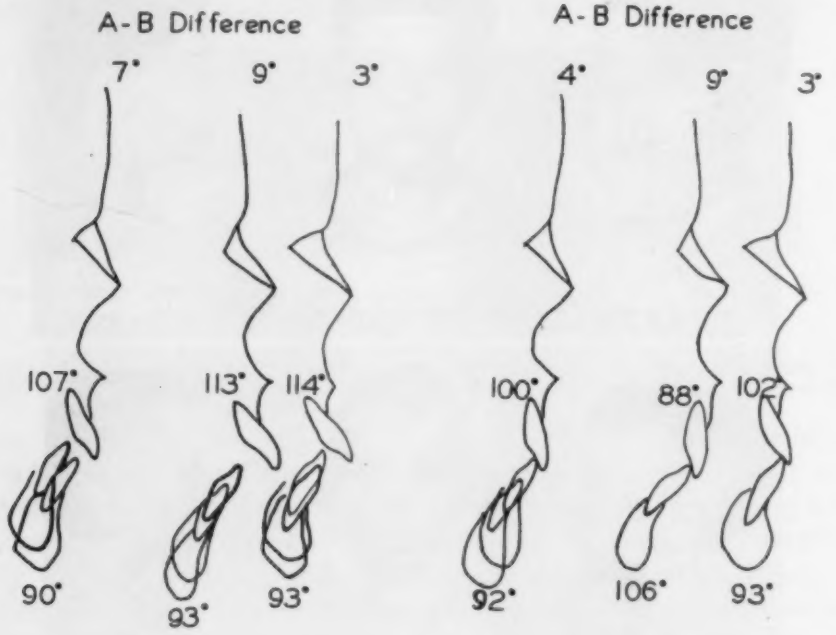

Fig. 15.

Fig. 16.

Fig. 15.—Partial cephalometric tracings and angular values of cases in Figs. 10 to 14, showing path of closure from physiologic rest to occlusion, apical base differences, and incisor inclination before treatment.

Fig. 16.—Partial cephalometric tracings and angular values of cases in Figs. 10 to 15, taken after treatment.

In Case 3, the maxillary incisors were tipped quite markedly to the labial. Restoration of incisal function was possible by tipping the upper incisors 11° lingually, with no change in the axial inclination of the mandibular incisors, since no mandibular appliance was used. Treatment was accomplished solely

by occipital anchorage over a ten-month period. The prognosis was good, the therapy simple. The key to success was found in the initial case analysis (Fig. 16).

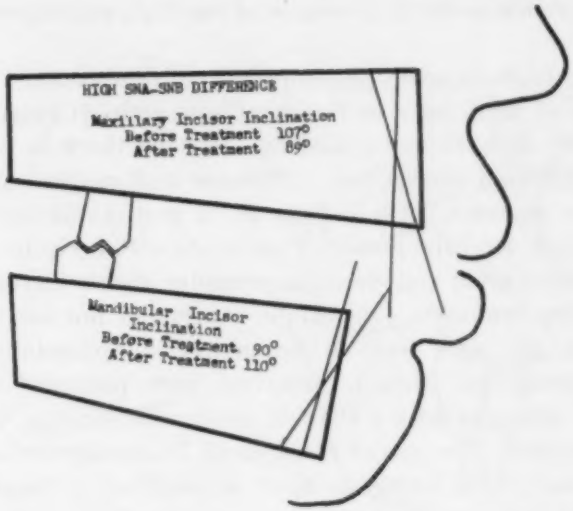

Fig. 17.

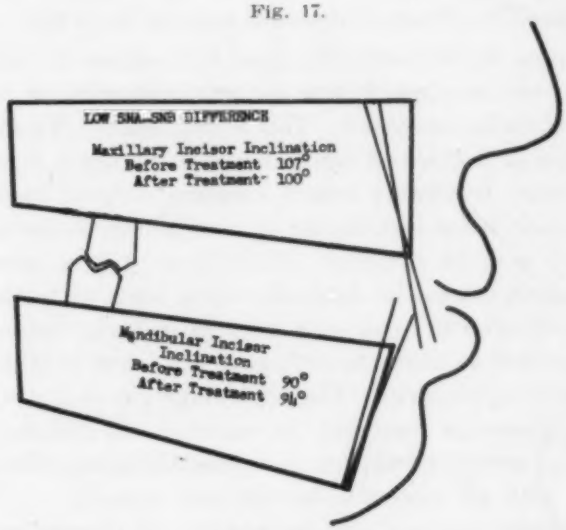

Fig. 18.

Figs. 17 and 18.—Diagrammatic representations of cases illustrating first a severe apical base dysplasia, and secondly, a moderate basal difference. Inclination of teeth is the same in both cases before therapy starts, but varies considerably after treatment.

The limitations imposed by apical base relationships can be shown diagrammatically (Figs. 17 and 18). The hypothetical cases start out with identical inclinations of the maxillary and mandibular teeth to their bony bases (maxillary incisors, 107°; mandibular incisors, 90°). On the completion of treatment, the diagram in Fig. 18 shows the upper incisors tipped lingually 7°, the lower incisors labially 4° into a normal overbite-overjet relationship. In Fig. 17, however, it took 18° and 20° for maxillary and mandibular inclination changes to produce the same normal overbite and overjet. Obviously, the difference lies

in the discrepancy of apical base relationships, anteroposteriorly. Fig. 19 is another case with marked labial tipping of the maxillary incisors. The prognosis is good because of the low AB difference. The same labial tipping in Fig. 20 is not amenable to stable correction because of the high anteroposterior basal bone disharmony.

The foregoing leads to some philosophical considerations. Firstly, the concept of extraction of teeth only in the maxillary arch. Cephalometric analysis demonstrates many skeletal malocclusions. Where there is a Class II molar relationship, with a high apical base difference and marked protrusion of the maxillary anterior segment, with no spaces, it may be better to sacrifice two upper first premolars, hold the posterior segments with occipital anchorage and a Nance lingual holding arch, and close the premolar spaces intramaxillarily by retracting the anterior segment. The Angle concept of normal interdigitation of posterior teeth at all costs was an important steppingstone in orthodontic progress. Experience has shown, however, that patients can masticate as efficiently in most instances with a Class II molar relationship, and still maintain a healthy environment. The recent research at Tufts substantiates this observation. Thus the concept of occlusion must be modified at times, where skeletal dysplasias produce unfavorable apical base relationships, making normal interdigitation most difficult to obtain, and almost impossible to hold.

Secondly, in poor facial patterns, axial inclination of the incisor teeth to their bases, and to one another, has to go by the boards as far as comparison to norm or mean values is concerned. This is important. To fit all patients into the Procrustean Bed of Statistical Normalcy is to render a disservice in skeletal dysplasias. Correction inevitably means excessive lingual inclination of maxillary incisors, excessive labial inclination of mandibular incisors, if anterior segmental relationship is to be restored. That there will be some return toward the original inclination cannot be doubted, which leads us to the conclusion that *there are certain orthodontic cases with very poor facial balance, high AB differences, that should not be treated*—unless we can learn to stimulate jaw growth per se by orthodontic appliances. The cephalometric radiograph tells us about those cases. If we choose to disregard the warning, the end result is failure. In still other cases, less severe in nature, it means being satisfied with an esthetic improvement, but with an excessive overjet still present.

Again, a cephalometric analysis (and study of plaster casts) may show a patient with a perfect mandibular arch, with normal lower incisor inclinations, no rotations, and adequate arch length, but with a total Class II relationship. It is my firm conviction that regardless of the appliance, prolonged intermaxillary elastics either tip the lower incisors forward, or slide the mandibular denture forward on its bony base. Specifically, this means in such cases to leave the mandibular denture alone, and to work on the maxillary denture only, gaining distal adjustment through occipital anchorage.* Does this always mean a perfect occlusion? No, but to pull on the lower denture in such cases may well mean ending up with the lower teeth in a poorer position than before treatment was started, with relapse inevitable. Here, again, we must avoid the Frankenstein

*A report on the importance of extraoral anchorage, and an appraisal of indications, contraindications, and results based on a sizable number of completed cases, is now being completed for early publication, in the department of orthodontics, Northwestern University.

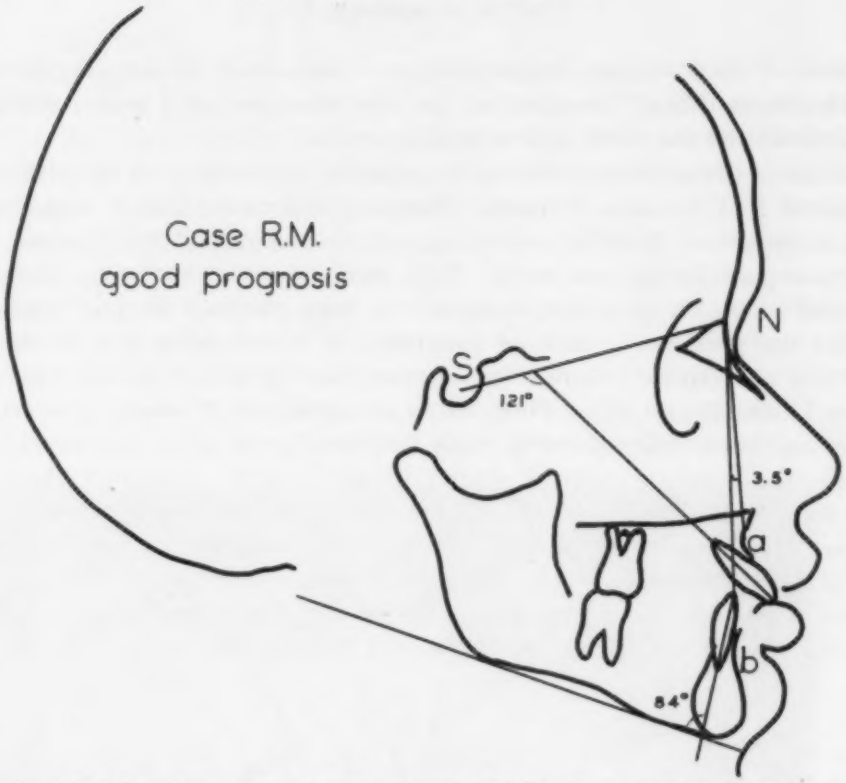

Fig. 19.—Good facial pattern; upper incisors tipped labially, lower incisors lingually inclined.

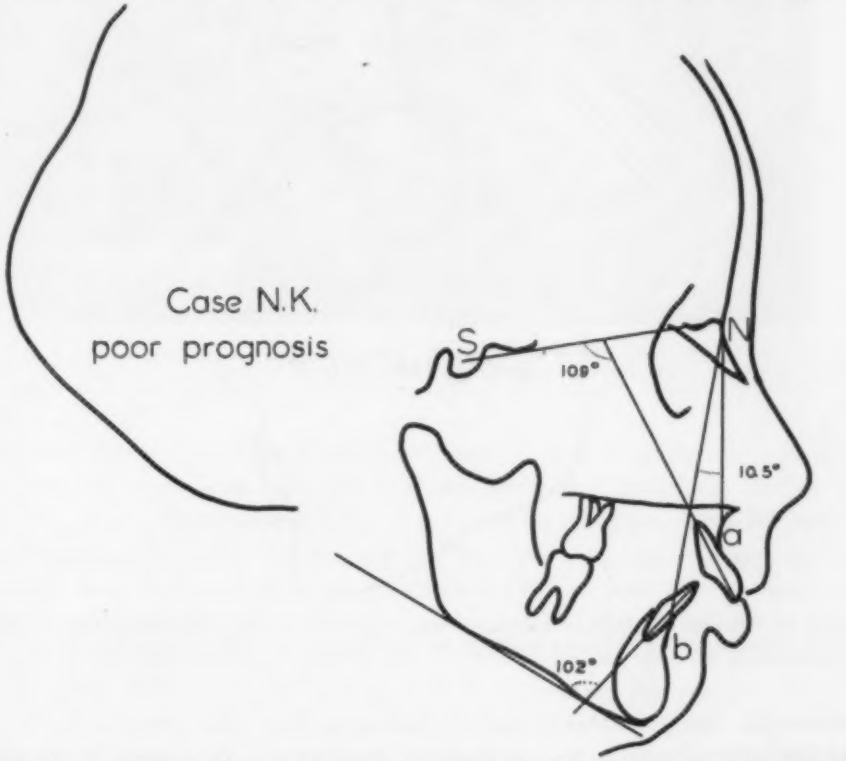

Fig. 20.—Poor facial pattern; upper incisors tipped labially, lower incisors also procumbent. Heroic measures are necessary here for orthodontic treatment to provide a stable result. Sacrifice of lower premolars, despite the excessive labial tipping of the mandibular incisors, might make restoration of normal incisor contact very difficult.

syndrome—*letting the appliance work us.* Periodontists can supply us with ample evidence that all too often we have let ideal occlusion be our sole goal, to the detriment of the teeth and investing tissues.

So much for cephalometrics as a diagnostic criterion, and the philosophical therapeutic considerations it fosters. In going back to the uses of cephalometrics, it has an important contribution to make in the analysis of treated cases, or as a progress report during treatment. With radiographs and tracings made before treatment starts, it is a simple matter to take pictures during treatment to measure the progress or lack of progress. A more objective position on the extraction of teeth as a therapeutic adjunct may be gained under these circumstances (Figs. 21 and 22). Those of us struggling with relapsing overbite and overjet and returning rotations, with four less teeth, may well find succor in periodic cephalometric progress reports during therapy. Certainly, there is some truth to the admittedly facetious observation of the prosthetist who gave a talk on "The Recovery of the Human Denture From the Pathologic Manipulations of Orthodontics." Our prognosis of treatment and the retention of the finished result without a retainer can be predicted to a large extent by a study of cephalometric headplates taken before, during, and after therapy.

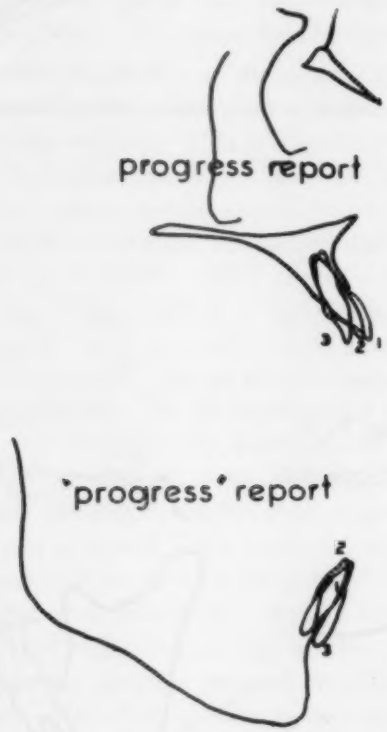

Fig. 21.—Serial tracings of the same case, taken at three different times, before, during, and after therapy. The changes induced by appliances are not necessarily beneficial, as the lower figure shows.

Granting the practical value of cephalometrics, can we justify the expense of the initial equipment, the expanse of floor space, the expenditure of time to avail ourselves of its use? Yes we can, if the equipment is simple and inexpensive enough, the demands on floor space either minimal or nil. Most of the

research on growth and development and the major portion of the evolution of cephalometrics as a diagnostic criterion has been accomplished with the Broadbent-Bolton cephalometer, the ultimate in scientific instruments of its type. Because of the high demands of accuracy for research, a target-film distance of 60 inches was used to provide reasonably parallel x-rays. Two D-3 x-ray heads were used for lateral and frontal pictures. (Fig. 23.) Subsequent research by Stackler has shown that the high degree of calibrated accuracy was not necessary for clinical use, and for angular cephalometric criteria.[2] Unfortunately, it still remains for the frontal headplate to be developed into a reliable clinical adjunct, despite frequent studies along this line. There are many excellent pieces of equipment available for making cephalometric radiographs. However, in the last 15 months at Northwestern University, Freeman

Fig. 22.—Lateral headplate of a "finished" orthodontic result, still under retention, and maintaining all teeth. A headplate taken prior to treatment might have prevented the inevitable collapse that will result when the retainers are discontinued. Note impaction of third molar teeth.

and Rasmusson have developed a portable head holder that should provide the clinician with an excellent orienter for use with the ordinary dental x-ray machine (Fig. 24). They cut down the target-film distance from 60 inches to 36 inches, and demonstrated by making analyses on both the conventional positioner and on their orienter that the cephalometric analysis was the same, with practically no variance in values for any particular patient. Instead of the central ray going through the ear rod, it was centered in the maxillary first molar area, bringing it right into the dental region to reduce peripheral distortion. By using a 5 by 7 inch film-holding cassette, instead of the usual 8 by 10 inch size, the available film area was reduced to that necessary for the cephalometric analysis, further reducing peripheral magnification, reducing the cost of the film, easing the storage problem, and allowing the use of ordinary dental intra-

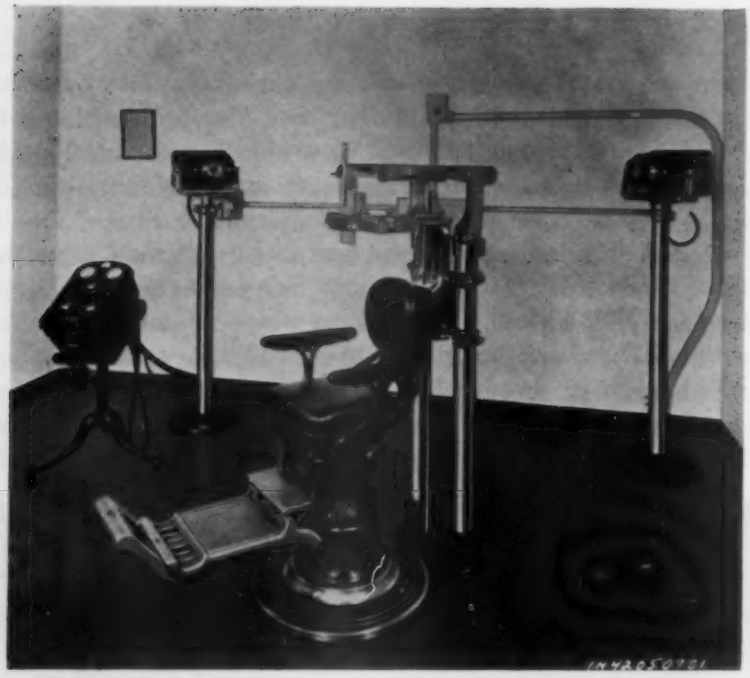

Fig. 23.—Broadbent-Bolton cephalometer (Northwestern University).

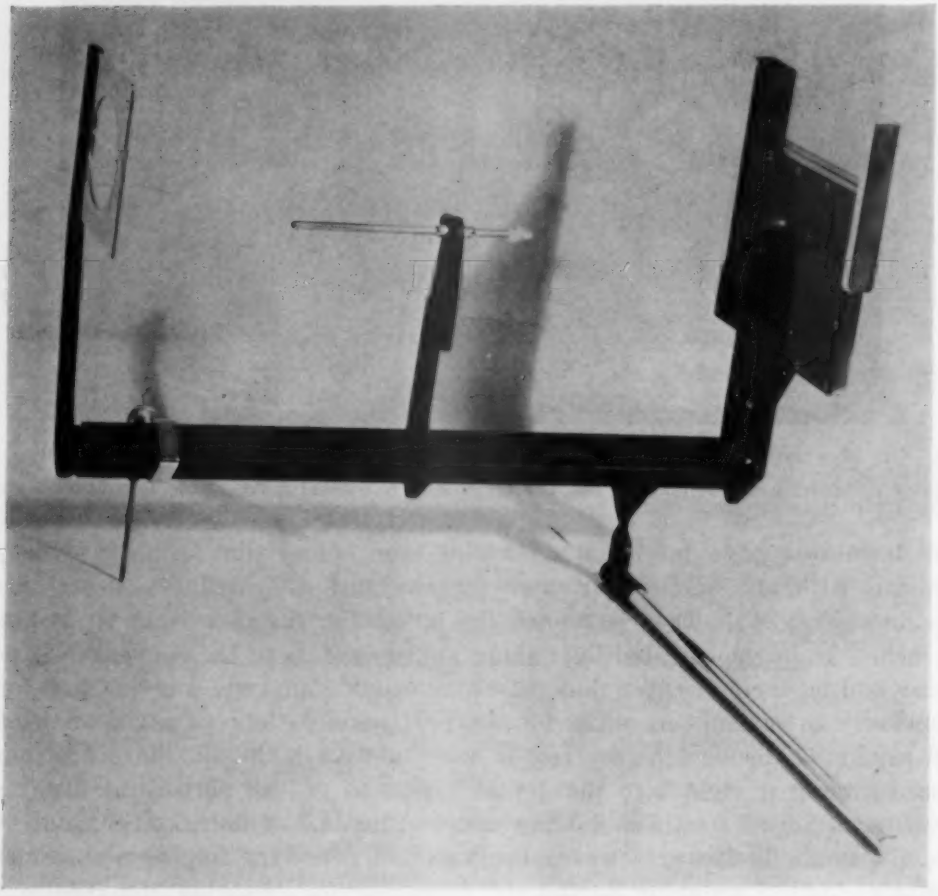

Fig. 24.—Freeman-Rasmusson orienter. Rod fits into a clamp on the back of the dental chair, or into headrest clamp.

oral x-ray developing tanks. The shorter target-film distance has the added advantage of a shorter exposure, averaging one to two seconds as compared to four to eight seconds for a dental machine at the 60 inch distance. (Both techniques require intensifying screens in the cassettes.) The orienter fits in the headrest holder of any dental chair with the aid of a modifying attachment, takes up no floor space when not in use, and can be stored away in a cabinet by telescoping it. It may also be used for orienting patients for photographs. Thus, we now have a simple, compact, efficient, and inexpensive mechanism for producing diagnostically acceptable cephalometric radiographs with the dental x-ray machine.

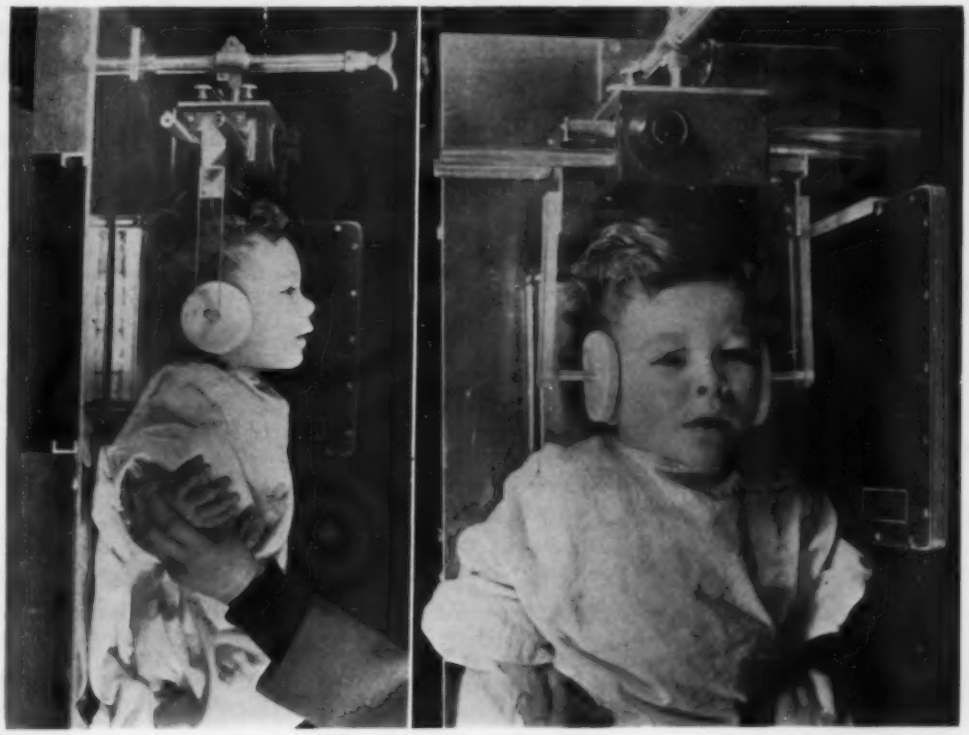

Fig. 25.—Northwestern cephalostat. This positioner is adaptable to hospital x-ray equipment, or to the ordinary dental x-ray machine. The child lies on his back during exposure.

The very young age group from birth to 3 years have presented problems of accurate positioning for some time. I have developed the Northwestern cephalostat for children in this range (Fig. 25). While primarily for children, the positioner can be adapted to adults by uprighting the base. This opens a new phase of cephalometric study. The growth and developmental patterns can be accurately measured and appraised with an eye for future departures from the normal.

In summary, cephalometrics is not a panacea for all our troubles. There is no substitute for clinical experience and judgment, but cephalometrics will help a great deal. It offers valuable assistance in growth and development appraisal, in picking up abnormalities, in studying facial type, and in arriving at a functional analysis. Its use as a diagnostic criterion is its most valuable contribution to clinical orthodontics, delineating the possibilities and limitations

of therapy. Its use as a progress report and in the study of completed cases provides a means of objective appraisal of therapeutic success and permits us to raise, or lower, our sights on a little sharper horizon.

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Erratum

Dr. Bernhard W. Weinberger is hereby given grateful credit for the loan of the photograph of the group at the Founders Dinner on page 78 of the article by Dr. Leuman M. Waugh entitled "American Association of Orthodontists," in the February issue of the Journal.

The middle of the fourth paragraph on page 77, in the same article, should be modified as follows:

From 1885 to 1892, he taught orthodontics at the University of Minnesota. Later he was made Professor of Orthodontics at the American College of Dental Surgery, now the Dental School of Northwestern University. Later he resigned because the faculty refused to have the students buy special books for orthodontic study and suitable instruments for clinical work. He then approached the dental faculty of the University of Pennsylvania, proposing that a department of orthodontics be formed, but to no avail. He then served as Professor of Orthodontia on the Faculty of the Dental Department of the Marion-Sims College of Medicine, St. Louis, Mo., from 1897 to 1899.

TREATMENT IN THE MIXED DENTITION PERIOD

FREDERICK T. BARICH, D.D.S., M.S.D., EVANSTON, ILL.

FROM the advent of modern orthodontics much has been written regarding the treatment of patients during the mixed dentition period. Some men felt that this was an ideal period for interference while others voiced the opposite opinion. Good arguments were presented by both sides. It appears that both sides were right on many of the issues and likewise that both sides were wrong on other points. Before the days when the biologic aspects took the fore nearly everyone thought that through appliance stimulation tardy bone growth could be accelerated and brought up to date; thus jaws could be widened and chins could be grown and gross facial deformities of all kinds could be corrected. From the works of Broadbent, Brodie, Thompson, and others, this concept has changed. For the first time this general road block changed the course of orthodontic thought and procedure. True and false mandibular positions can now be determined with a good degree of accuracy so the good results in all classifications of malocclusions where this condition existed can now be readily explained. One does not hear too much about long and short rami anymore, but we do know a great deal more about the deep anterior overbite or vertical dimension as the result of freeway space recognition. The terms infra- and supraversion have now taken on a greater significance.

The general reaction and potentialities of alveolar bone are becoming clearer as new light is being shed on this phase of the orthodontic problem. We are approaching the whole problem with more than one eye open. The researchers of the future will further approach that goal. By learning more about the organism with which we are dealing we are becoming more and more aware of the procedures which actually bring clinical results. We also are able to recognize more of the variations which may modify or postpone any orthodontic procedure. A great amount of this knowledge has come from the clinical testing ground where, by the trial-and-error method, workers have discovered that some procedures work favorably while others fail to produce the desired results. This situation is found in cases which appear to be similar or parallel in all of the diagnostic aspects.

There are many cases which may be treated wholly or partially in the mixed dentition. There is one single factor which should always be held foremost in the mind of the operator and in any case this should be a signal argument for correction at the immediate moment. That factor is the psychological impact of the malocclusion on the individual patient. If this is present something should be done to alleviate it. The merciful bounds of such procedure need no further comment.

Read before Northwestern University's Centennial Dental Meeting, June 6-9, 1951.

Before enumerating the situations which are amenable to treatment by classification it might be more conducive to clarity first to list the generalities. The following conditions should be treated:

1. All cross-bites, anterior and posterior.
2. All malocclusions which are caused by habits should be corrected as early as possible and a fervent effort should be made to break the habit.
3. All cases of mesial and distal tipping or drifting of permanent teeth.
4. Deep anterior overbites.
5. Imminent transpositions of lower permanent lateral incisors and permanent cuspids and upper first premolars and permanent cuspid teeth.
6. Irregularities caused by supernumerary teeth.
7. Congenitally missing teeth conditions.
8. Labium frenum cases.
9. Conditions caused by tumors, cysts, periodontal disease, rickets, and congenital clefts of all kinds.
10. Ankylosed deciduous teeth irregularities.
11. Ectopic eruptions of teeth with special emphasis on the 6-year molars.
12. All cases in which arches have collapsed in whole or in part but in which arch length was not involved in the process.

Relative to classification such as Angle's it may be stated that practically all classifications can be treated in the mixed dentition period. Some of these cases might require some finishing at a later date, but to me that procedure has proved to work satisfactorily for all concerned. If it is at all possible to restore normal occlusion at any age the mechanism has a far better chance to come to fruition because the natural forces which produce the occlusion can do a better job than all of the appliances at our disposal. In the over-all sense treatment during this period may be regarded as an early assist to nature so that she may proceed unhampered in the development of so-called normal occlusion.

The only types of cases regardless of classification that do not respect early interference in all of its aspects are those in which arch length is inadequate or definitely shortened and the extreme conditions of which we are all aware. The former are the potential extraction cases and may be left for treatment until a later date. In many of these cases, however, some preliminary treatment may be instituted such as reduction of arch relationships or reduction of deep anterior overbites, or both in any given case. Serial extractions of the deciduous teeth with arch support by lingual appliances as advocated by Nance have produced excellent results. Many times these latter basic procedures will simplify or possibly expedite the later treatment program.

It is recognized that no hard fast rules can be laid down for orthodontics at large. Many situations are handled differently by different individuals and many parallel problems come to successful terminations regardless of the time of interference. The choice lies with the individual and it is he and he alone who knows what and when he can do best with any given case. This is the conduct which I pursue because I have the conviction that it constitutes sensible orthodontic practice.

The method is unimportant. Suffice it to say that any mechanism which will effectively reduce the malocclusion may be employed in any case. The most important phase of orthodontic procedure is the diagnosis or case analysis if you will. If the starting point is erroneous then all that follows must be faulty; so it goes without saying that the result regardless of age will reflect and magnify the initial error.

Mother Nature usually does a pretty fair job, but she fails more often than not to produce absolute perfection in anything; if she is given an assist she will go on to produce a much better thing, and that thing to us is the elusive entity known as normal occlusion.

The following case reports show cases in different categories of malocclusion where early treatment was instituted and no further effort was required in order to produce the final occlusion.

Fig. 1.

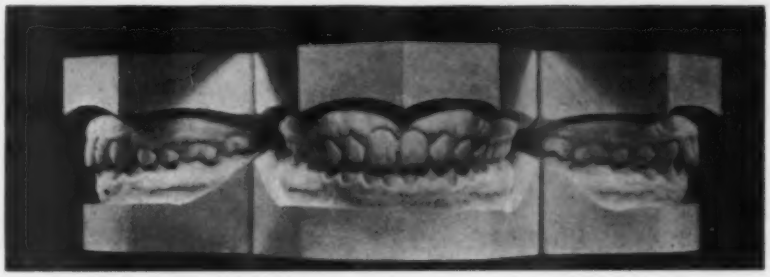

Fig. 2.

CASE REPORTS

Case 1 (Our Case 399).—B. W. was a white girl aged 8 years, 6 months.

Diagnosis: This case was diagnosed as a Class I (Angle) malocclusion.

History and general clinical picture: Chicken pox and mild anemia were the only childhood disorders. The mother had a similar malocclusion which was not treated and this fact is what provoked the concern for her daughter.

Etiology: The early loss of the lower left deciduous cuspid had caused a collapse and a shift to the left of the lower anterior segment. This was augmented by a lower lip habit which also caused protrusion of the upper anterior segment. Both upper and lower anterior segments were in supraversion.

Plan of treatment: A plain round labial arch with intermaxillary hooks and a sharp spur in the midline to dissuade the lower lip habit were placed on

the maxillary arch. The lower arch carried a fixed removable lingual mechanism with a finger spring in its anterior aspect in order to position the lower incisors.

Progress of case: Treatment was commenced in November, 1944, and was continued until December, 1945, or approximately one year. The elastics were worn steadily for three months. At that time an eight-hour period was advised in order to control the gain. Elastic activity was intermittent until the end of active treatment when it was thought that the lip habit was under full control.

Secondary treatment (retention): A Hawley type retainer with bite plane was placed on the upper arch and the lingual arch was modified to serve as a retainer in the lower arch. The mechanisms were worn until June, 1946, or a period of six months, when they were removed.

Results achieved: Subsequent inspection showed that all treatment objectives were holding well. The final models were made in April, 1951, practically five years after retention.

Case 2 (Our Case 2).—R. H. was a white girl aged 7 years, 9 months.

Diagnosis: This case is a Class I (Angle) malocclusion with mesial tipping of right and left 6-year molars, thus placing them in Class II relationship with their fellows of the lower arch. The relationship of mandible to maxilla, however, appears to be wholly within the Class I range. The maxillary arch is narrowed in all dimensions; this may be due to loss of arch length as mentioned previously. The central incisors are spaced and in torsiversion and the lateral incisors are in slight labioversion. The upper right first premolar is in partial eruption while its fellow on the opposite side shows that it too will appear soon.

The mandibular arch is well developed and well formed, but there appears to be a slight shift of the anterior teeth to the lingual and to the left. This has disturbed the upper and lower cuspid relationship on that side and also has shifted the midline slightly to the left. First and second premolars on the left side are in the process of eruption. Slight supraversion may exist in the anterior segment. The eruption of the permanent teeth denotes the physiological age is well in advance of chronological age. The intraoral x-rays verify this finding, and also reveal that all permanent teeth except the third molars (plates were not placed far enough distally to reveal them) are present and in an advanced state of development. The third molars may be present. All other intraoral x-ray findings appear to be within normal limits; in other words, nothing of an unusual nature was found.

History and general clinical picture: Chicken pox and measles at 4 and 5 years, respectively, and mild whooping cough at 2 years were the only diseases which plagued this child. Her general health was good although she appeared to be a bit underweight. Mental health was also good and the posture was excellent. There was no evidence of external pressure habits of any kind but she did roll the side of the tongue between the upper central incisors. There was no evidence of endocrine disturbance of any kind. Rampant caries was evident

in the deciduous teeth. Both parents had good occlusions, but an uncle on the father's side had a similar malocclusion which I had treated twelve years previously. Despite this, any hereditary factor was ruled out.

Etiology: The factors which produced this irregularity were the rampant caries and resultant early loss of the upper second deciduous molars and the mild tongue habit which produced the diastema between the upper central incisors.

Plan of treatment: The over-all plan was to move the upper first permanent molars distally until they occluded with the lower molars, thus recreating the space for the premolars and cuspids; align and rotate the upper incisors and align the lower anterior segment, particularly on the left side.

Fig. 3.

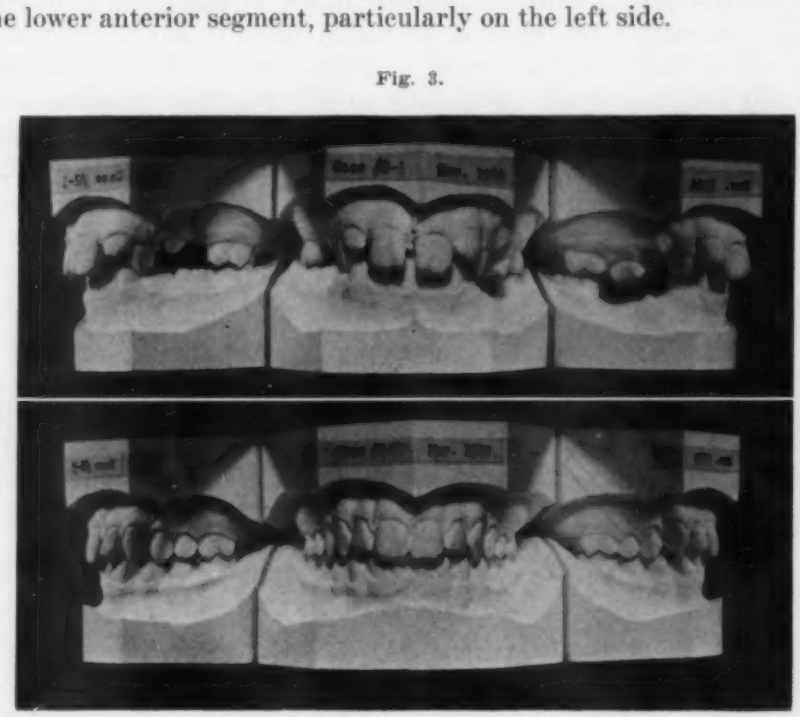

Fig. 4.

The maxillary arch carried a plain round labial arch with intermaxillary hooks and the mandibular arch carried a fixed removable lingual appliance. After the upper 6-year molars were moved distally with Class II intermaxillary rubber bands, to their proper positions, the incisors were banded and McCoy tube attachments were used to complete their alignment. An auxiliary spring was used from the lower lingual mechanism to effect the alignment of the lower anterior segment. No supplemental therapy was used in this case.

Progress of case: This child was seen at two-week intervals from November, 1944, until December, 1945, or a period of fourteen months was required to establish the occlusion. This patient gave full cooperation and there were no complications of any kind.

Secondary treatment: The treatment appliances were worn in retention until June, 1946, when they were removed. No other retaining device was deemed necessary because the remaining permanent teeth were erupting at an accelerated rate. At this time it was thought that additional treatment might be necessary so no models were made.

Results achieved: It is apparent that all objectives in treatment had been attained. The posterior occlusion is well established; the upper anterior teeth are in good alignment and the lower anterior segment is holding as placed in treatment.

Observations and conclusions: This case, although treated at the age of 7 years, 9 months, proves quite conclusively to me, at least, that a malocclusion which might necessitate the removal of dental units if left untreated until a later date was averted. An important consideration in this case was the rapid or accelerated eruption of the permanent teeth. The final intraoral x-rays reveal that the teeth, particularly the roots, which show no evidence of resorption, are in excellent condition. The third molars are congenitally absent. The supporting tissues are all in excellent condition; in fact all structures are well within the realm of normality.

It may be noted on the cephalometric headplate that both stylohyoid ligaments are calcified. This is a rare finding, indeed, because it is the second on record by the radiographer.

Posttreatment findings: This child at 13 years of age shows spacing in both arches despite the use of intermaxillary force. It is my belief that the occlusion will be better as the years go by without any further orthodontic interference. It may be said in conclusion that more than the initial objectives had been attained in this particular case.

Case 3 (Our Case 122).—A. H was a white girl, aged 7 years, 10 months.

Diagnosis: This case is essentially a Class I (Angle) malocclusion. The maxillary arch appears to be constricted in the deciduous molar regions, and there is an ectopic eruption tendency in the right 6-year molar. Both 6-year molars are slightly rotated. The anterior segment is flattened and the midline has shifted to the right about two-thirds of the mesiodistal diameter of the lower permanent central incisor. The left central incisor is in slight torsiversion and partial linguoversion; and both later incisors are in linguoversion. The right deciduous cuspid is in slight labioversion. The mandibular arch is well formed, but there is a slight narrowing of the buccal segments. On close inspection the mandible was found to shift slightly to the left on closure. Both 6-year molars are in mesiotorsiversion and the right molar is also tipped to the lingual. From the intraoral x-rays it may be discerned that all of the permanent teeth are well advanced in their development, thus indicating that this dentition will arrive at an earlier age than the average. Other roentgenographic findings are negligible.

History and general clinical picture: Outside of chicken pox and measles this patient had an uneventful infancy and childhood. General health, nu-

trition, mental development and posture were excellent. Mild caries was present. The presence of tonsils and an enlarged mass of adenoid tissue thickened the speech. Removal of both was advocated. In the swallowing act the lower jaw was thrust forward and undue tension of the upper lip was noted. She was the only child. The father had a near normal occlusion, but the mother had an extreme Class III malocclusion. I might add that the mother's concern lest the daughter pattern after her prompted the initial interview. The mother had not received any kind of orthodontic treatment.

Etiology: The perverted action of the facial musculature in swallowing plus the inadvertent aping of the mother's facial acts were, in my opinion, the prime etiological factors in this case.

Plan of treatment: The general plan of treatment was to expand the maxillary arch in three directions, e.g., bilaterally and anteriorly, and after sufficient space was acquired the anterior segment would then be moved to the left.

Fig. 5.

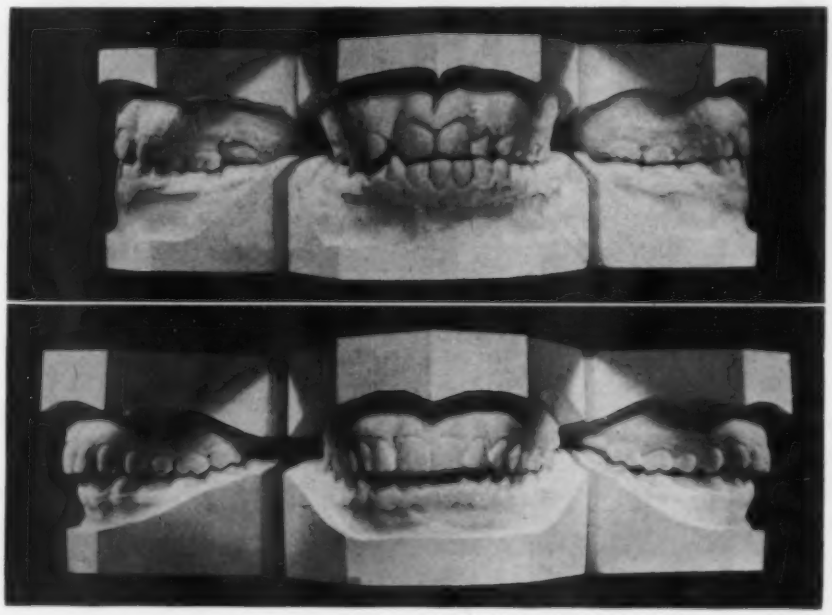

Fig. 6.

In the mandibular arch enough bilateral expansion was planned to coincide with that of the maxillary arch.

A McCoy tube appliance with lingual extensions was employed on the maxillary arch; and a plain round labial arch and lingual extensions were used on the mandibular arch. Class III hooks were placed on the lower labial arch in order to bolster the upper anchorage teeth if necessary.

Supplemental therapy consisted of proper swallowing exercises plus advice on same to mother.

Progress of case: This case was treated at two-week intervals with the exception of one month due to illness. Active treatment was commenced in March, 1935, and was terminated in May, 1936, an interval of fourteen months. The lower appliance, however, was removed in March, 1936.

Secondary treatment (retention): At completion of active treatment the upper appliance was removed and a lingual appliance placed to act as a retainer; it was worn for one year.

Results achieved: Facial, dental, and functional results apparently were improved.

Observations and conclusions: The patient, after thirteen years, has a pleasing face and a near normal occlusion.

Case 4 (Our Case 161).—L. O. was a white boy exactly 8 years of age.

Diagnosis: This case might be classified as Class III subdivision (Angle) malocclusion.

Fig. 7.

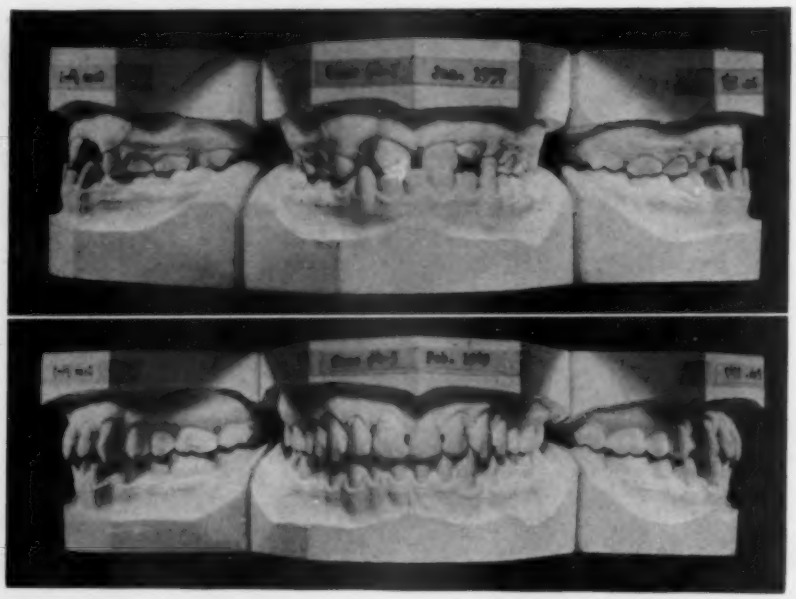

Fig. 8.

The maxillary arch is fairly well formed with no perceptible shortening of arch length. All of the anterior teeth are in linguoversion as is the right first permanent molar. The left first permanent molar is slightly rotated.

The mandibular arch is well formed and the right first permanent molar is in buccoversion. Midline is to the left indicating that the mandible is in protrusion and shifted to one side.

The intraoral x-rays showed that everything was progressing normally.

History and general clinical picture: There was nothing in the history to indicate or suspect anything except normality. Physical development was good as was the posture. There were no pressure habits, caries was mild, and the parents and one brother had near normal occlusions.

Etiology: It was not possible to determine the causative factors responsible for this malocclusion.

Plan of treatment: The general plan was to unlock the anterior occlusion, reduce the right first permanent molar cross-bite, and swing the mandible back to the neutral position on the right side.

A McCoy tube appliance was used on the maxillary arch with an intermaxillary hook on the lingual aspect of the right molar band. On the lower arch a plain round labial arch with Class III intermaxillary hooks was employed in conjunction with an intermaxillary hook on the right molar buccal tube.

No supplemental therapy was deemed necessary in this case.

Progress of case: This boy was seen every two weeks for a period of eighteen months in order to establish the normal anatomical and functional relationships. The response to treatment was good and the cooperation was excellent.

Secondary treatment (retention): The treatment appliances were worn in retention for one year after which they were removed. No further retention of any kind was used. As a matter of fact I had anticipated another active treatment period, perhaps at 13 years of age, but subsequent checkups showed this to be unnecessary. No additional treatment of any sort was necessary.

Results achieved: Facial, oral, dental, as well as functional, conditions were all noticeably improved. After the case was completed, any and all factors which might have inhibited the growth pattern apparently were eliminated because this face and all contiguous parts progressed to normalcy without incident. Final x-rays reveal the congenital absence of the lower third molars, but this factor failed to play a role in the development of the mandible. However, if the third molars had been present, they might have aided in the consummation of the occlusion.

Observations and conclusions: The dentitions, mixed and permanent, and contiguous parts developed uneventfully and without further orthodontic aid to approximate normality. The final models (Fig. 8) portray the above eleven years after retention. The patient at the time of writing was 20 years of age.

CONCLUSIONS

1. Practically all types of cases may be treated during the mixed dentition period.

2. Cases in which arch length is definitely shortened may be treated basically at this time and finished at a later date.

3. Where a psychological factor exists an attempt should be made in order to alleviate it.

4. The method is unimportant.

5. The natural forces of occlusion should be brought to function as early as possible in order to encourage the maximum potential development of the oral mechanism.

CEPHALOMETRIC X-RAY TRACING UTILITY TABLE

A. I. Fingeroth, D.D.S., New Rochelle, N. Y.

IN THE light of present-day evidence, anatomical diagnosis, in addition to clinical diagnosis, is among the essential data upon which an intelligent diagnosis and prognosis should rest.

The purpose of this clinic is to give a brief account of the technique and principles involved in constructing a practical office x-ray table for tracing cephalometric x-rays and to fulfill the demand for a unit which will permit the profession to improve the quality of the cephalometric interpretations.

This relatively simple technique, set up for making a precise and permanent record of the status and progress of the dentofacial developmental changes, establishes the orthodontist in a position to serve more adequately the needs of the patient placed under his care for orthodontic supervision.

Keeping in mind that most orthodontic offices must of necessity conserve space for essential equipment, this table was constructed with a twofold purpose:

1. To be used conveniently as a cephalometric x-ray tracing table (Fig. 1).
2. As an auxiliary table on casters in the treatment room by simply placing a towel across the work top, thus assisting at the chair with the individually required armamentarium (Fig. 2).

Fig. 3 shows the full view of the convertible x-ray table with the following comfortable working dimensions:

Height	32 inches
Width	15 inches
Length	24 inches

A drawer, 6¼ inches deep, on runners, containing a fluorescent bulb painted with white enamel to intensify the light, was built underneath the work top (Fig. 4).

In order to obtain the proper concentration of light and to eliminate shadowing these conditions were established:

One eight-watt fluorescent bulb was built into the drawer four inches beneath the translucent glass. A mirror was placed on either side of the bulb at an angulation of 35 degrees to step up the intensity of light to three times its voltage and to diffuse the light.

Either side of the partitioned drawer is of sufficient dimensions to enclose x-rays, tracing materials, tape, rulers, erasers, triangles, etc.

The dimensions of the transparent inset on the work top are 10 inches by 12 inches by ¼ inch. This can be set in both the horizontal and vertical planes and can be masked to accommodate smaller x-rays.

This construction will assure the orthodontist a simple, expedient table with variable uses, showing many advantages over the standard x-ray illuminating box.

The Pintard Bldg., 650 Main St.

Presented as a clinic before the annual meeting of the Northeastern Society of Orthodontists, New York, N. Y., March 3, 1952.

Fig. 1.

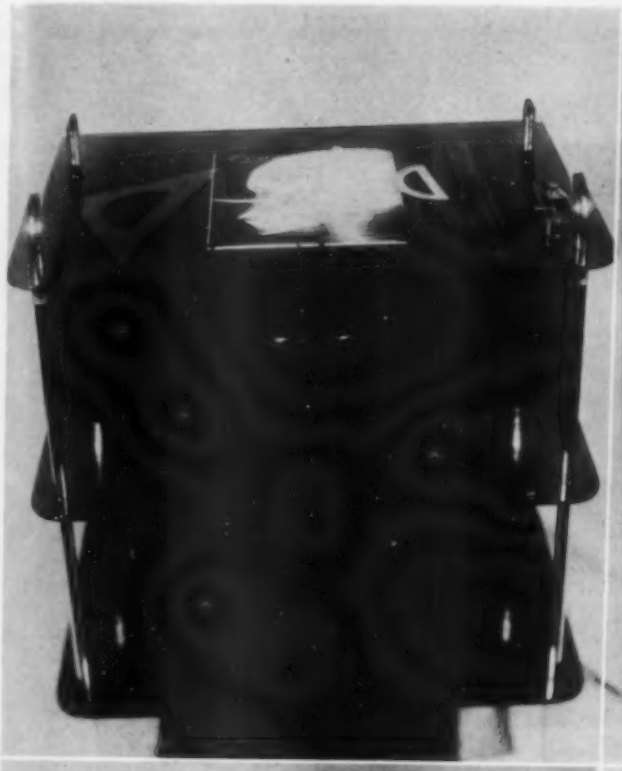

Fig. 2.

Fig. 3.

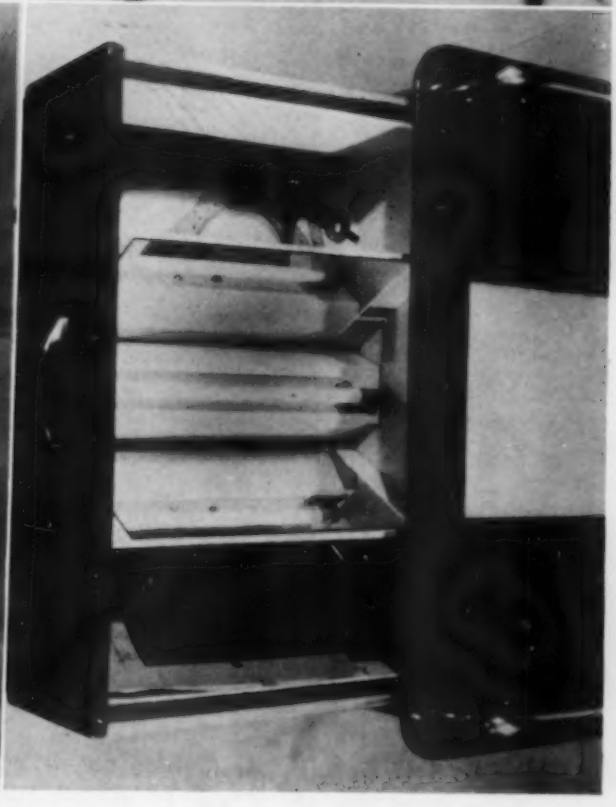

Fig. 4.

BILATERAL CLASS II, DIVISION 1 MALOCCLUSION

JAMES C. BROUSSEAU, D.D.S., BATON ROUGE, LA.

REPORT OF A CASE

THE patient, L. P., was a white boy, aged 14 years, 10 months, when first seen in November, 1946.

Diagnosis: Bilateral Class II, Division 1 malocclusion and dental malfunction due to retrusion of the entire mandible, with extreme and complete cross-bite of the left maxillary and mandibular premolars and molars. The lingual surface of the maxillary premolars and molars on the affected side was in contact with the buccal surface of the mandibular premolars and molars. The vertical height appeared less on the left side, producing a distortion in the patient's facial contour. The mandibular anterior teeth were in supraversion and were in contact with the soft tissue of the palate. X-rays revealed four possible third molar impactions.

History and General Clinical Picture.—The patient was a quiet, unassuming boy of average intelligence, with poor posture and average general physical condition. Childhood diseases included measles, mumps, and chicken pox. Tonsils and adenoids were still present and he had no history of major operations. Tissue tone was poor; hygiene, poor; tongue and oral mucosa were normal; swallowing was normal; respiration and speech were normal; family background, history of Class II tendency on maternal side.

Etiology.—Etiology was obscure, but the patient's parents stated that he slept on his left arm and leaned on the affected side when not occupied. As stated previously there was a Class II history on his mother's side of the family. The complete absence of occlusion on the left side plus the extreme Class II relationship and cross-bite produced a facial distortion and imbalance.

Plan of Treatment.—

A. *General plan:* Correct cross-bite and re-establish the integrity of both arches. Attempt to increase vertical dimensions by opening the bite and restoring correct mesiodistal relationship of arches and teeth by carrying the mandible anteriorly.

B. *Appliances used:* Bands were constructed and cemented on the mandibular and maxillary premolars and molars in December, 1946. Elastic hooks were soldered directly on the bands in question, on the lingual in the maxillary arches and on the buccal in the mandibular arch. The patient wore large cross-bite elastics from each maxillary band to the comparable tooth in the mandibular arch. The thought will enter your mind that this is a tremendous amount of elastic pressure, but it was my feeling that because of the depth of the extreme cross-bite the mode of treatment was justified. The cross-bite was corrected by March, 1947. It was observed at this time that in correcting the cross-bite the Class II relationship was also corrected (unintentional).

Fig. 1.—L. P., 14 years, 10 months, November, 1946.

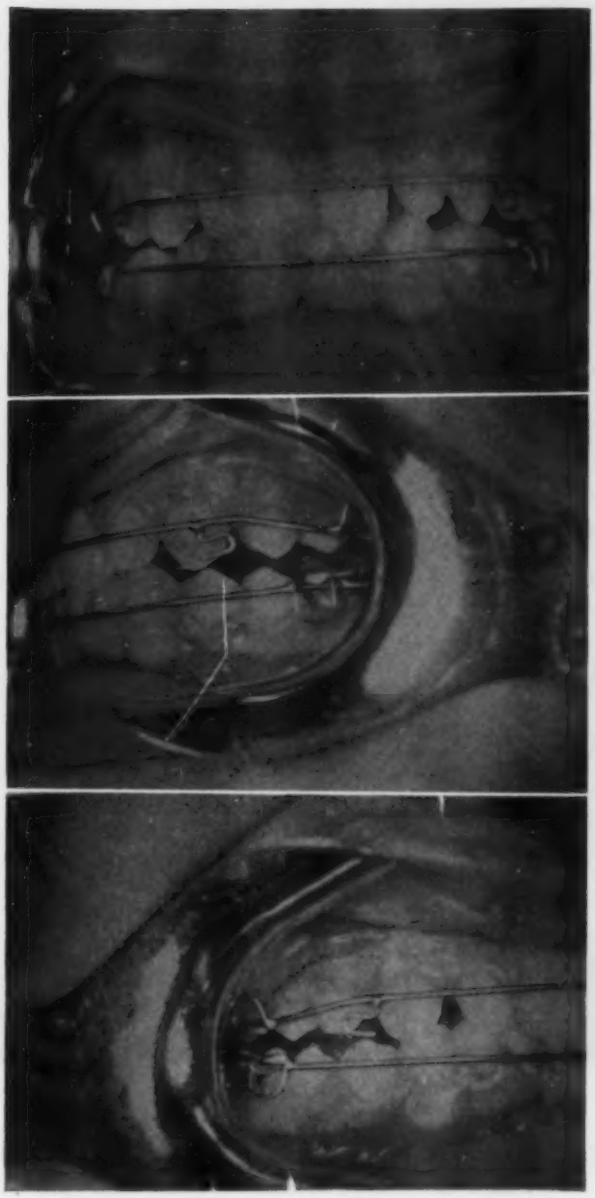

Fig. 2.—L. P., 16 years, 4 months, March, 1949.

Analysis of the pressure utilized showed the cross-bite elastics also acted in a mesiodistal relationship, thus correcting the Class II relationship on that side. Maxillary and mandibular labial and lingual appliances were constructed and

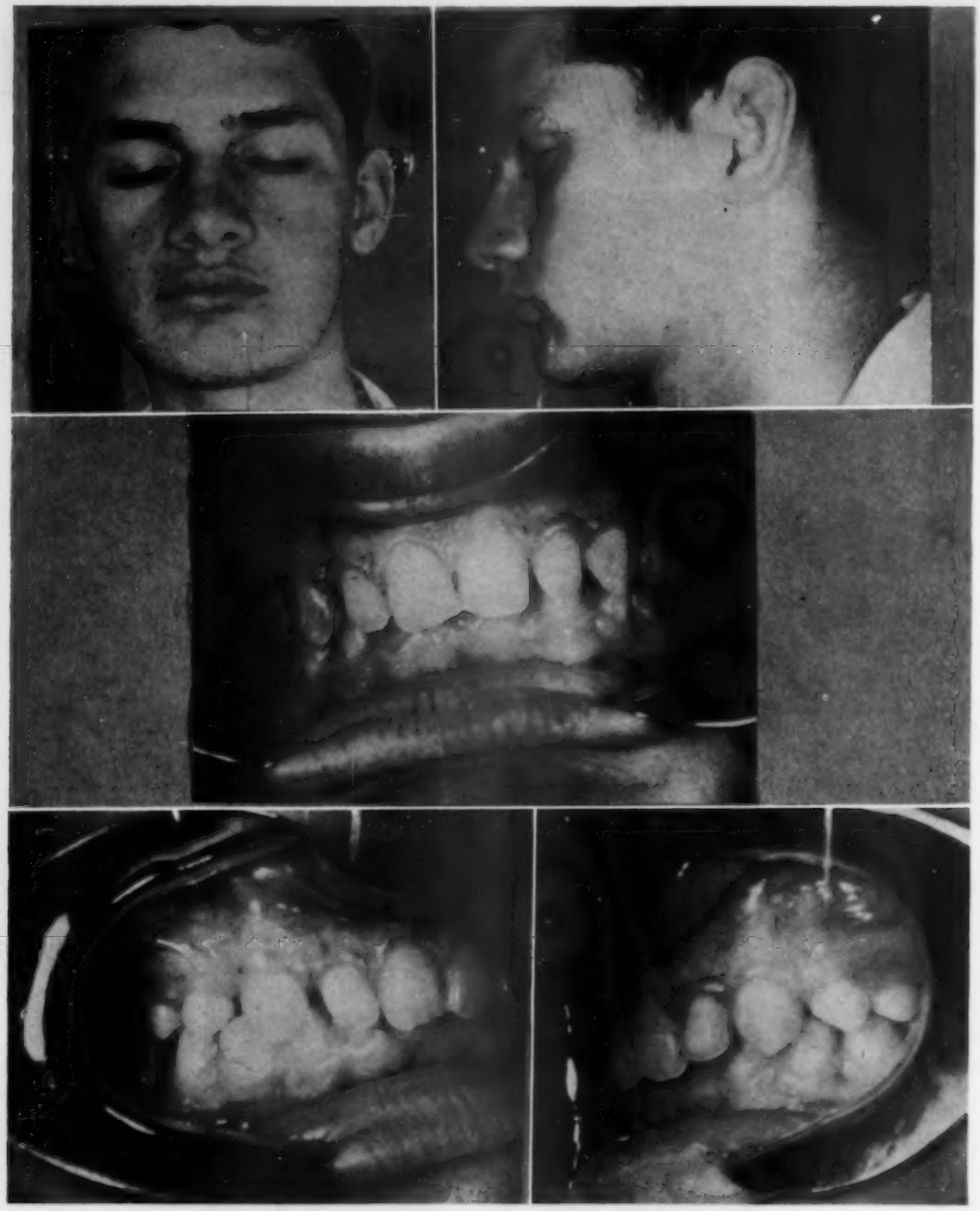

Fig. 3.—L. P., 18 years, 6 months.

Class II elastic pressures were instituted. In January, 1948, the Class II relationship on the right side approached normal and the maxillary anterior teeth were started distally. In August, 1948, record impressions were made

and a mandibular lingual appliance and maxillary labial appliance were constructed and cemented as retaining appliances.

Progress of Case.—The patient was seen at three-week intervals during treatment period. Cooperation was good during early stages of treatment but deteriorated as treatment progressed. Hygiene was very poor and necessitated frequent removal of appliances in order to restore tone to gingiva.

Fig. 4.—Retainer used.

Secondary Treatment.—In March, 1949, treatment was reinstated because the bite appeared to have closed considerably. An occlusal guide plane was constructed and inserted with maxillary labial and mandibular labial and lingual appliances. Class II elasties were instituted. In December, 1949, record impressions were made and Nobillium casting made as a retainer which the patient was instructed to wear nightly for the rest of his lifetime.

Results Achieved.—Esthetic and functional results were good when one recalls the case at its beginning. Treatment objectives were not fully attained in that the mandibular anterior teeth were still in supraversion because the secondary treatment did not prove too successful in attempting to open the bite.

Observations and Conclusions.—The results achieved in this particular case may not be too satisfactory by some clinicians but, by my standards, when one reviews the treatment history and the case when treatment was instituted, I cannot help but feel gratified for what has been accomplished.

701 N. Seventh St.

American Board of Orthodontics

At its April, 1952, meeting the Directors of the American Board of Orthodontics agreed to make certain changes in eligibility requirements, copy of which follows:

"The following are eligibility requirements of applicants:

"(a) He must have been in the exclusive practice of Orthodontics for at least five years at the time of filing application.

"(b) In computing this five year requirement, time spent in special training in Orthodontics may be included.

"(c) His minimum training requirements shall be:

"1. Sixteen months successfully completed graduate or postgraduate orthodontic training in an accredited university school; or

"2. Eight months university graduate or postgraduate orthodontic training in an accredited university school *plus* (a) twelve months full time preceptorship in the office of an A. A. of O. member, or by spending sufficient time in hospitals, clinics, or fundamental science laboratories recognized by the Council on Dental Education of the A. D. A. and by the A. B. O. as competent to provide an equivalent adequate training in Orthodontics, or (b) twenty-four months supervisory preceptorship as defined below; or

"3. Twenty-four months full time preceptorship in the office of an A. A. of O. member or its equivalent including the attendance of acceptable special orthodontic courses or in hospitals, clinics, or fundamental science laboratories recognized by the Council on Dental Education of the A. D. A. and by the A. B. O. as competent to provide an equivalent adequate training in Orthodontics; or

"4. Twelve months full-time preceptorship in the office of an A. A. of O. member *plus* twenty-four months supervisory preceptorship or an equivalent to the above which may include the attendance of acceptable special orthodontic courses or in hospitals, clinics, or fundamental science laboratories recognized by the Council on Dental Education of the A. D. A. and by the A. B. O. as competent to provide an equivalent adequate training in Orthodontics; or

"5. Forty-eight months supervisory preceptorship or an equivalent which may include the attendance of acceptable special orthodontic courses or in hospitals, clinics or fundamental science laboratories recognized by the Council on Dental Education of the A. D. A. and by the A. B. O. as competent to provide an equivalent adequate training in orthodontics.

"(d) Teaching or a fellowship in the field of the specialty may be considered in partial fulfillment of this requirement.

"(e) Satisfactory moral and ethical standing in the dental profession.

"(f) Citizenship in the United States. A Citizen of Canada who meets all other requirements may be eligible to receive an 'affiliate certificate.'

"(g) Graduation from a dental school accredited or otherwise recognized by the Council on Dental Education.

"(h) A license to practice dentistry issued by a legally constituted examining board or other legally constituted authority in the United States or Canada.

"(i) Membership in the American Dental Association, National Dental Association or the Canadian Dental Association, and the American Association of Orthodontists.

"DEFINITION OF PRECEPTORSHIPS

"1. *A Preceptorship* shall consist of full time association in the office of an A. A. of O. member. Such a preceptor would be expected to conscientiously do all he could to determine applicant's ability. He would appraise the extent and quality of records for diagnosis and treatment planning and offer proper suggestion for improvement.

"A suitable form will be supplied by the A. B. O. to be filled in by the preceptor to give full and confidential reports on the applicant.

"The Director of the American Board of Orthodontics located nearest the applicant should be consulted concerning any preceptorship arrangement to establish eligibility for A. B. O. certification.

"2. *A Supervisory Preceptorship* shall consist of supervision by an A. A. O. member the same as by a preceptor as above described except that the applicant need not be associated in the office of his preceptor.

"Identical provisions shall prevail in regard to forms for confidential reports."

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

The Mesiobuccal Root of the Maxillary First Molar. By Spencer R. Atkinson. (Reprinted from *South California State D. J.* **19**: 17-27, 1951.)

. . . . . .

The posterior portion of the alveolar process, distal to the key ridge, houses the three rooted molar teeth. The process anterior to the key ridge accommodates single rooted teeth.

For tearing, the canine is employed but for maximum crushing the first molars are the answer. As the tooth does heavy chewing its support must be strong and dependable.

Normally, the alveolar process in this region is thick and well formed. This tooth is provided with three roots. The lingual root is more or less round, long and strong. The two buccal roots are well formed, having a gentle curve backward and conforming to the type of that particular individual, thus receiving and distributing force in the direction in which it is best absorbed.

Figure 1 is the skull of a young adult showing the maxillary first permanent molar, ideally placed, the mesiobuccal root following exactly the curve of the key ridge. At earlier ages the first molar is relatively distal to the key ridge and moves forward with growth of the dental arch.

In infancy, when the primary incisors appear as in figure 2, the maxillary permanent molar crypt is high up, distal to the tuberosity, just under the orbit. When this tooth begins to calcify, the occlusal surface of the crown points backward.

An x-ray taken vertically, of the maxilla, as in figure 3, reveals ample space between the buccal and lingual walls for the growth of three rooted teeth. This space narrows as the canine fossa is approached.

At six years of age the maxillary first permanent molars are coming into occlusion. Their roots are not fully formed, the characteristic curve of the buccal roots harmonizing with the type of the individual. The occlusal surface of the maxillary molar at this stage of growth has a distal inclination while that of the mandibular molar, a slightly forward inclination.

At six years of age the maxillary root is fully protected by ample space filled with bone building material, distal to the key ridge.

In young children, figure 5, there is much space between the buccal and lingual walls of the alveolar process. These walls close in with increasing age and vertical growth.

Figure 6. At about nine years of age a similar section will disclose the first permanent molar moving forward in this channel between the buccal and lingual walls, approaching the canine fossa. The space between the walls of the maxilla are narrowing and will eventually limit the forward growth of the first permanent molar.

An adult skull in normal occlusion, figure 7, will show the mesiobuccal root of the maxillary first permanent molar just under the key ridge and the suture

between the maxillary and palatine bones, to be opposite the middle of the second permanent molars. In figure 3, at one year of age, it is distal to the center of the second primary molar. At six, figure 5, it is opposite the center of the first permanent molar. At nine it is distal to these teeth and figure 7, a young adult, is opposite the middle of the second molars.

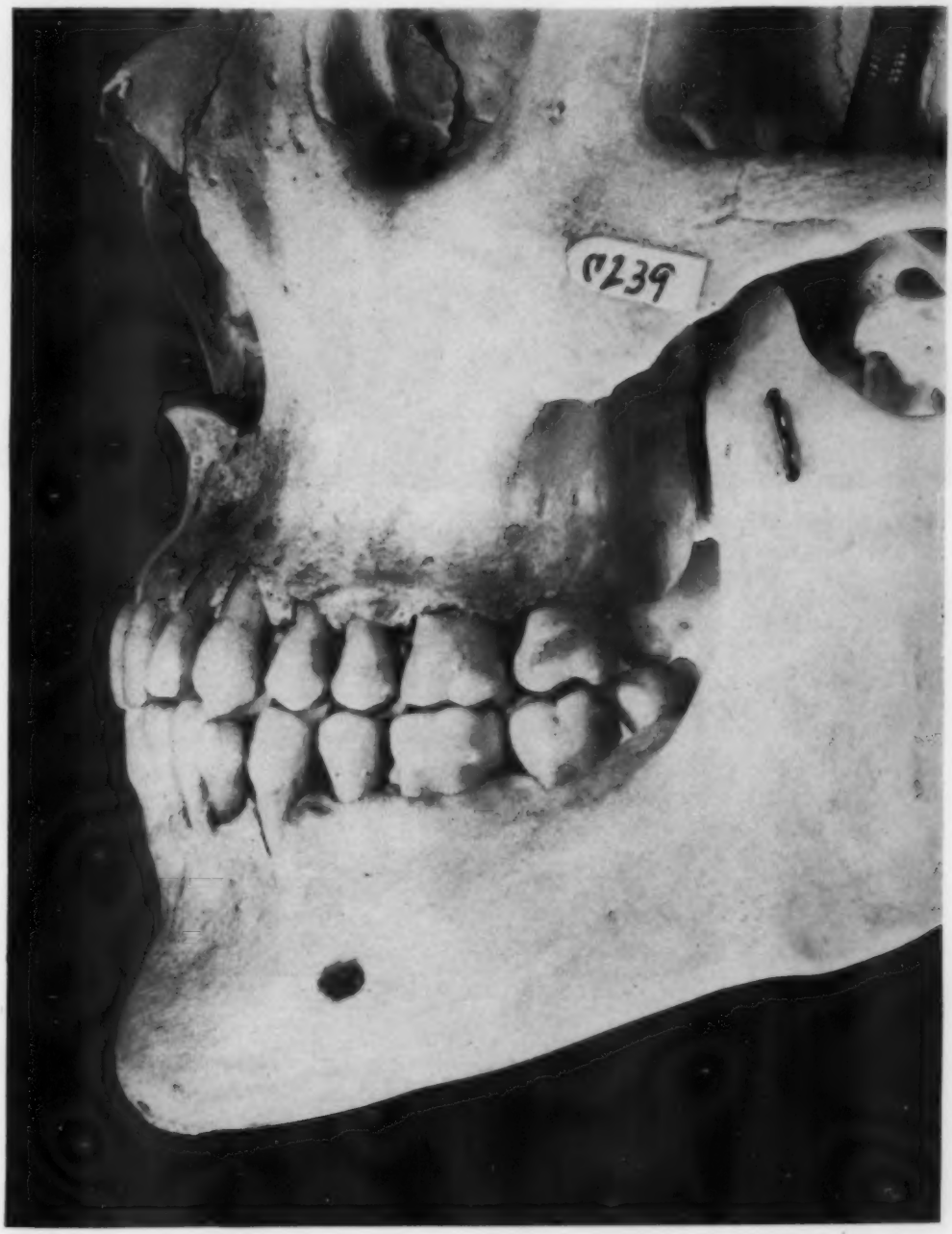

Fig. 1.—Normal occlusion of a young adult, showing the proper placement of the maxillary first permanent molar. The mesiobuccal root being at the crest of the strong ridge of bone descending from the molar bone and being the anterior border of the jugal buttress.

Fig. 2.—At one year of age with the anterior teeth just erupted, to some extent inhibiting the backward and forward movement of the jaw. The first permanent molar is well up above the tuberosity, near the level of the floor of the orbit.

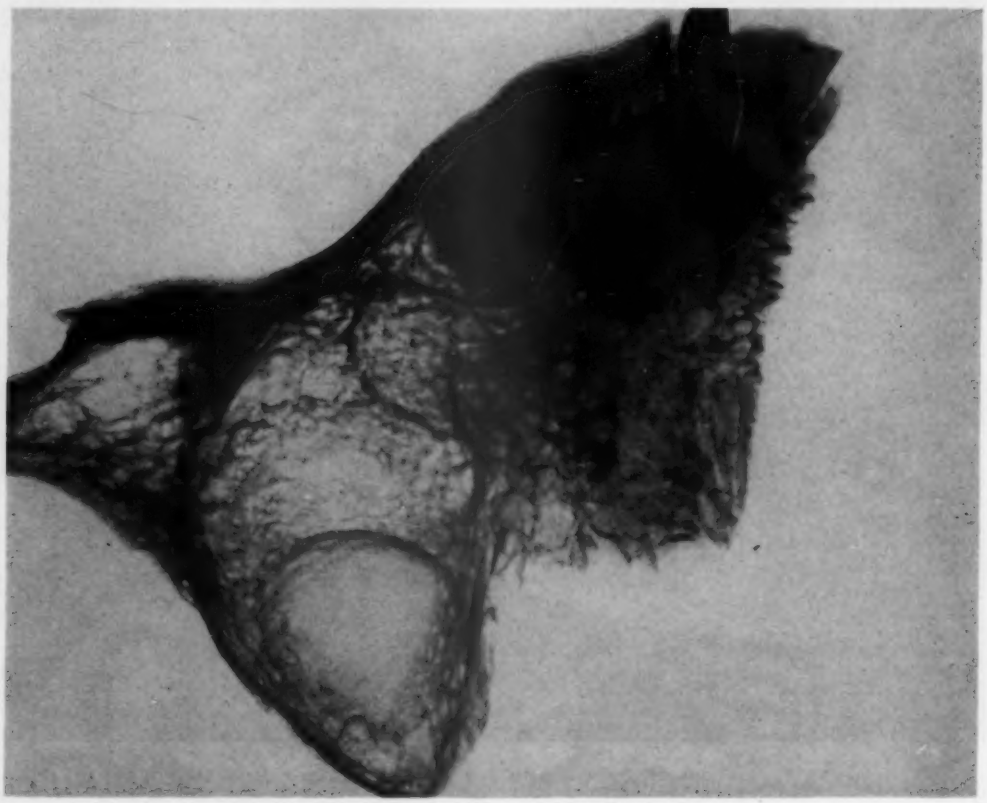

Fig. 3.—An x-ray picture of a child at birth, taken in a vertical direction, showing the large space between buccal and lingual wall. The suture between the palate and maxillary bones is opposite the distal portion of the second primary molar.

Fig. 4.—Approximately six years of age with the buccal plate of bone removed, showing the maxillary six year molar inclined slightly to the distal and distal to the key ridge.

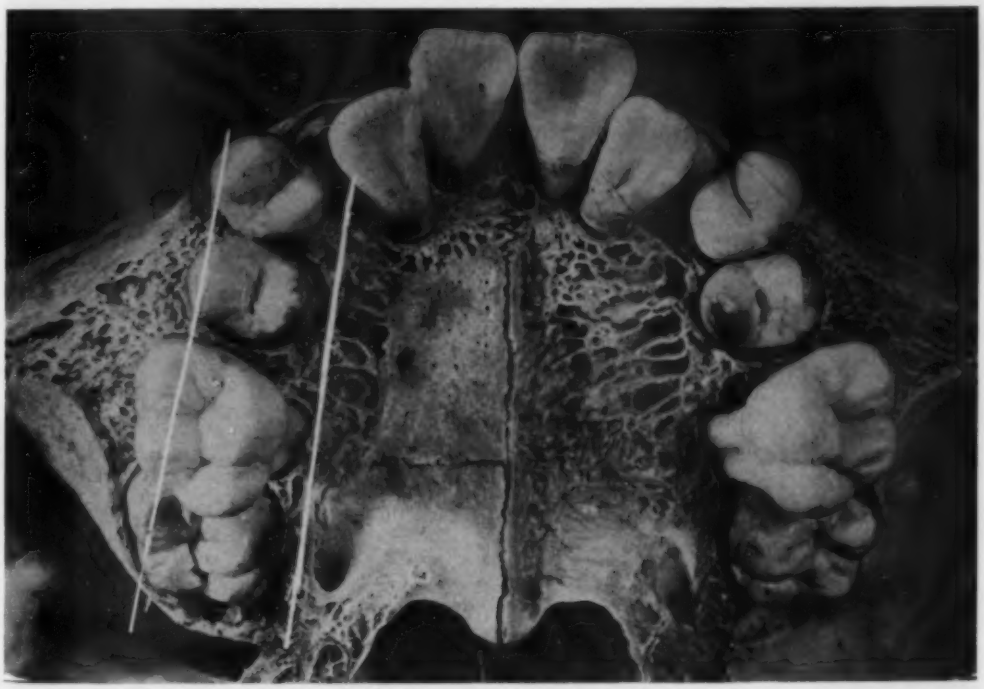

Fig. 5.—A section of the upper jaw of a child approximately six years of age with the border of the alveolar process removed approximately two thirds of the length of the roots of the teeth. Two white lines are drawn along the line of growth of the buccal teeth. At about eighteen years of age the buccal wall of the maxillae will limit the forward growth of the first permanent molar. This picture shows the suture joining the palate and maxillary bones to be opposite the middle portion of the first permanent molar. Also the great amount of cancellous bone on either side of the growing teeth between the buccal and lingual plates.

Figure 8. A transverse section of the skull of a young adult with normal occlusion. The buccal and lingual walls of the alveolar process have grown vertically and approached each other to the extent of having no extra space for further drifting forward of the first permanent molars. Hard cortical bone grows inward on the anterior aspect of the mesiobuccal root of the first molar to insure the maintenance of proper position of the tooth.

Fig. 6.—A child approximately nine years of age, showing the forward growth of the teeth in relation to the key ridge and the suture which joins the palate bone with the maxillary bone and the converging or drawing in of the two plates of bone as age increases.

A horizontal section, figure 9, gives another view of this condition. The walls and process are both thin and dense, more concerned with maintaining the teeth as they are than in future growth. This is not so much the case in children; the walls both buccal and lingual are very vascular and more responsive to change. Should for some reason, the buccal plate of bone to the distal of the canine fossa fail to arrest the forward growth of the first molar and the molar not rotate, the upper half of the mesiobuccal root penetrates the side of the buccal plate of the alveolar process.

Figure 10. When this occurs, the peridental membrane coming in contact with periosteum will be destroyed. Under these conditions not only is this area of the peridental membrane destroyed but the root of the tooth itself is attacked. The longer this condition continues, the more resulting damage is experienced.

Fig. 7.—Occlusal view of the maxillae of a young adult showing the proper placement of the first permanent molar in relation to the key ridge and to the transverse palatine suture. The suture when age is fully attained is opposite the middle of the second permanent molar as is seen in this illustration.

Figure 11. After a period of time this condition becomees quite serious, especially if the bridge of bone at the alveolaar border, as "A" in figure 11, is destroyed. In such a case one would immediately have a pocket full of infection up the entire unattached buccal wall of the molar, followed by the loss of this tooth.

This condition may be recognized in its incipient stage and prevented from occurring, by orthodontic means, if treated at the proper time. Uncertainty of obtaining desired results increases with age. The younger the patient the more promising the prognosis. The condition, slight or otherwise, may be recognized by the study of plaster casts or actual clinical examination.

Fig. 8.—A section through the maxilla at the crest of the key ridge demonstrating the thinness of the alveolar process as maturity is attained. There will be a sharp convergence of the buccal and lingual plates of bone of the maxilla, just anterior to this first permanent molar.

Fig. 9.—A transverse section at about one half of the roots of the teeth showing the alveolus of the three roots of the first permanent molar and the convergence of the two plates of bone just anterior to the key ridge. This illustrates that there is ample room for three rooted teeth distal to the key ridge but only sufficient room anterior to the key ridge for the single rooted teeth.

Fig. 10. (*For legend, see opposite page.*)

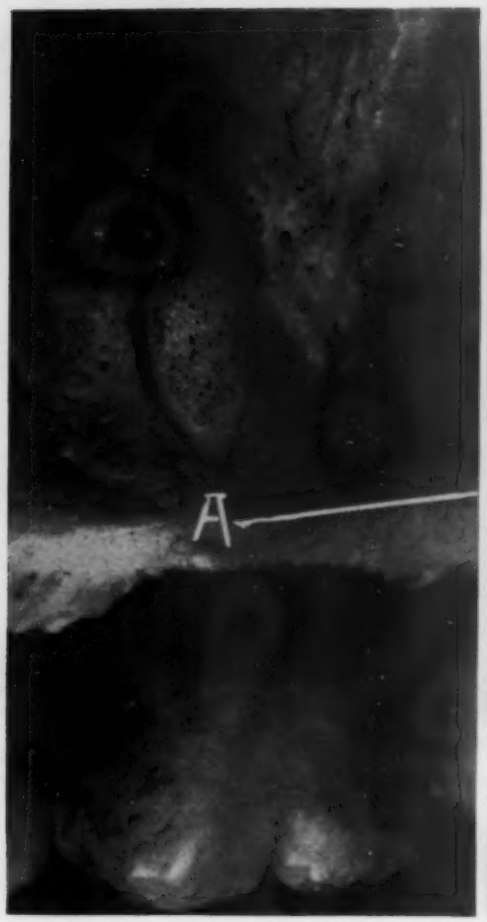

Fig. 11.

Fig. 12.

Figs. 11 and 12. (*For legend, see opposite page.*)

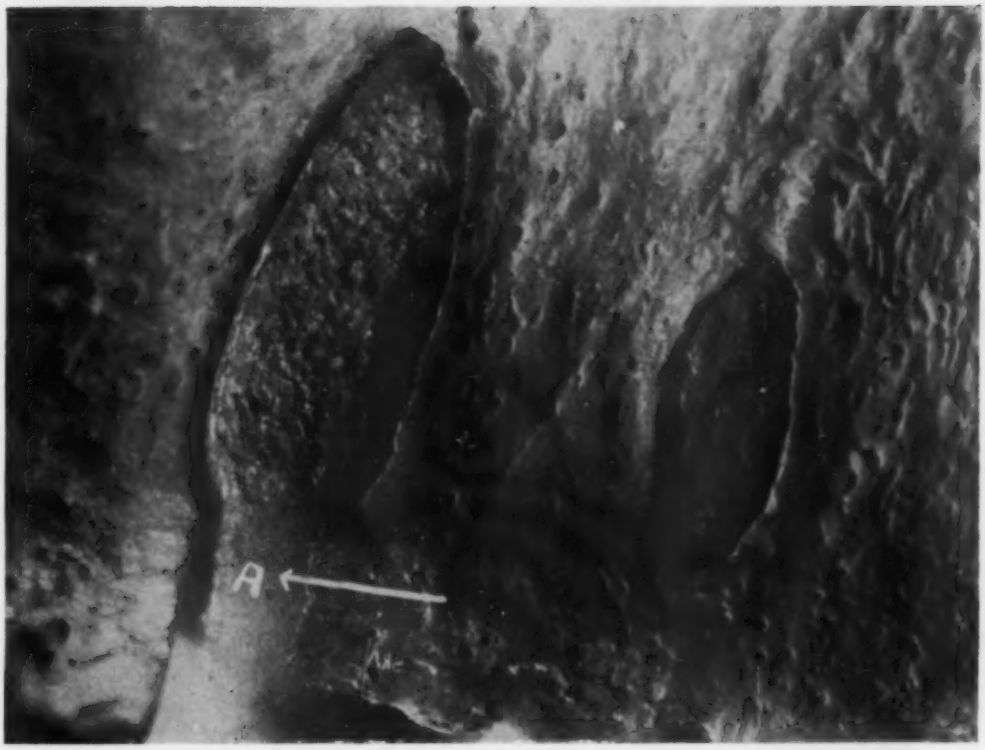

Fig. 13.—Another specimen in which the roots were denuded and the bridge of bone dissected away so as to show healthy cementum under this bridge of bone. The eating away of the root occurs only when the periosteum and peridental membrane come in contact. In this instance, the area of the root at the point "A" was protected by the bridge of bone.

Fig. 10.—Shows the mesiobuccal root of the upper first molar protruding through the alveolar process. The pitting or eating away of the cementum and dentine of the buccal surface of this root as a result of the peridental membrane coming in contact with periosteum. This denuding will continue. A recovery from this condition seems to be impossible.

Fig. 11.—An enlargement of the area referred to in Figure 10. If the narrow bridge of bone at "A" is destroyed by periodontal disease then immediately there will be a pocket extending the length of the root to this tooth.

Fig. 12.—The enlargement of the mesiobuccal root of an upper six molar which has protruded through the process. There is marked destruction to the root of this particular tooth.

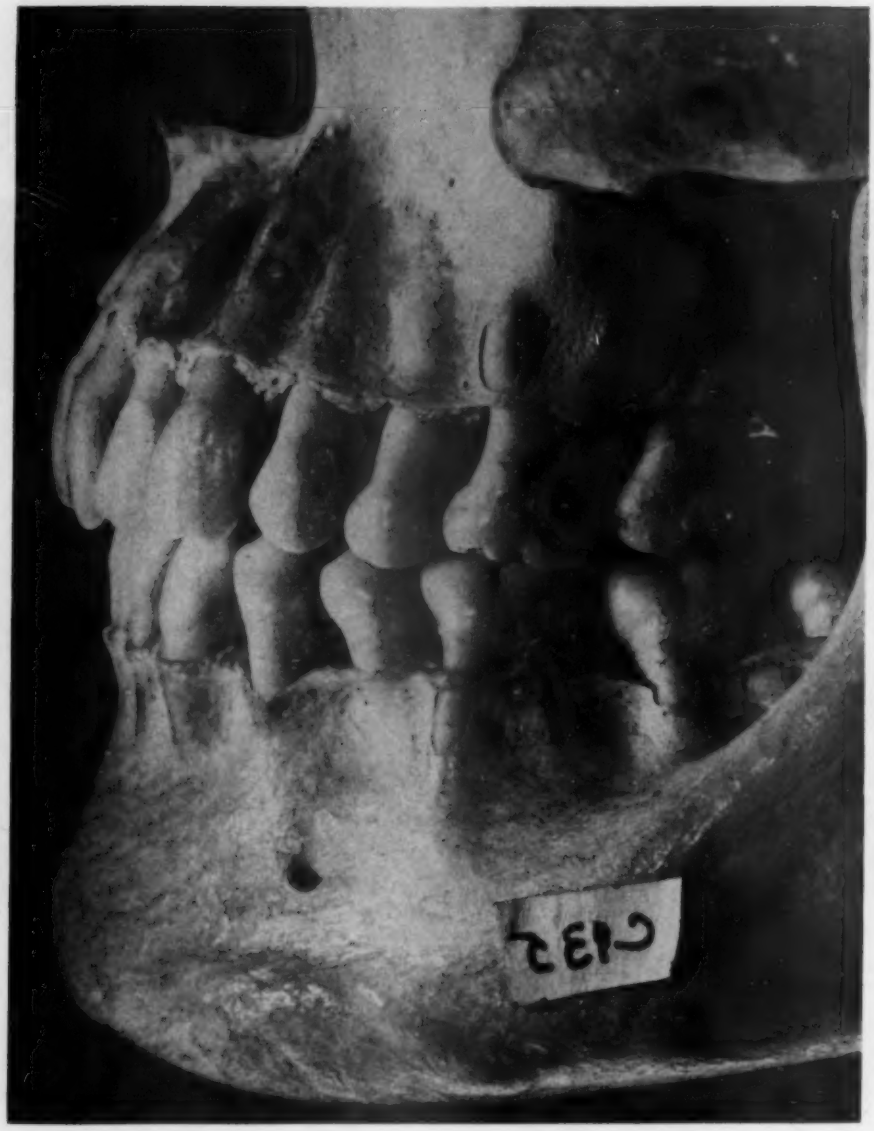

Fig. 14.—That of a skull of an individual whose system was depleted of calcium with the rapid recession of the alveolar crest and excessive converging of the buccal and lingual plates of bone thus partially exposing the roots of both the maxillary and mandibular first molar teeth. Note also the prominence of the roots of the anterior maxillary teeth. This being due to the removal of large amounts of calcium from the body tissues.

In cases of malocclusion involving double protrusion or the drifting of the first permanent molar due to extraction or mutilation, the mesiobuccal roots of both the maxillary and mandibular teeth are involved. This is one mutilation which when once present does not regenerate or repair.

There are three well known conditions under which this trouble may occur: Number 1. Cases of malocclusion involving maxillary or double protrusion. Number 2. From lack of proper diet or otherwise there is a marked calcium deficiency as figure 14. . . .

Number 3. Extraction of buccal teeth anterior to the first permanent molar.

News and Notes

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Baker Hotel, Dallas, Texas, April 22 to April 26, 1953. Orthodontists who desire to be certified by the Board may obtain application blanks from the Secretary, Dr. C. Edward Martinek, 661 Fisher Bldg., Detroit 2, Mich. To be considered at the Dallas meeting, all applications must be filed before March 1, 1953.

Northeastern Society of Orthodontists

The next meeting of the Northeastern Society of Orthodontists will be held at the Mount Royal Hotel, Montreal, Canada, on Monday and Tuesday, Nov. 10 and 11, 1952.

Central Section of the American Association of Orthodontists

The 1952 meeting of the Central Section of the American Association of Orthodontists will be held Oct. 13 and 14, 1952, at the Fontenelle Hotel in Omaha, Neb.

Southwestern Society of Orthodontists

The next meeting of the Southwestern Society of Orthodontists will be Oct. 26 through Oct. 29, 1952. Headquarters, Gunter Hotel, San Antonio, with Dr. Dan Peavy presiding.

European Orthodontic Society

Two items from the program of the European Orthodontic Society meeting follow:

10:00 to 10:45 A.M. Dr. Allan G. Brodie, Chicago, U.S.A. Principles of Treatment on the Edgewise Philosophy and Appliances.

11:00 to 11:45 A.M. Dr. Andrew F. Jackson, Philadelphia, U.S.A. Orthodontics: Its Nature, Objectives, and Therapy From the Basis of Infinite Variation.

Synopsis: A Direct Comprehensive Method of Evaluating Factors and Dealing With Clinical Problems by Employing *Principles of Treatment of Universal Application* in Which a *Wide Variety* of Appliances Find the Conditions Best Suited for Their *Specific Usefulness.*

Illustrated with a large number of Kodachrome slides showing a wide range of case histories which were treated from the standpoint of this basic philosophy.

Iowa Orthodontic Study Club

The fourth annual meeting of the Iowa Orthodontic Study Club was held June 6, 1952, at Iowa City, Iowa.

Guest essayist was Dr. Clare K. Madden, Greenwich, Conn. Dr. Madden presented a very complete review regarding the construction and clinical use of the twin wire mechanism, supplementing his lecture with a beautiful display of models and projections.

The officers elected for the 1952-1953 period are as follows: President, Dr. Kennith J. Alley, Des Moines, Iowa; Secretary-Treasurer, Dr. Jackson H. Roe, Iowa City, Iowa.

Seminar for the Study and Practice of Dental Medicine

Two hundred dentists, including top dental-medical researchers, will be in attendance at the Ninth Annual Seminar for the Study and Practice of Dental Medicine set for the Desert Inn, Palm Springs, Calif., Oct. 26 through Oct. 30, 1952.

Advance registration, according to an announcement by Dr. Hermann Becks, President and Founder of the Seminar, indicates a capacity turnout for the five-day study session.

Denver Summer Seminar

The Denver Summer Seminar, organized in 1936 by students and friends of Dr. Albert H. Ketcham, is dedicated to his memory.

The Fifteenth Annual Seminar was held at the Park Lane Hotel, Denver, Colo., Aug. 3-8, 1952. Those who appeared on the program of the Seminar were: Dr. Samuel D. Gore, New Orleans, La.; Dr. Hermann Becks, San Francisco, Calif.; Dr. Isaac Shour, Chicago, Ill.; Dr. Archie Brusse, Denver, Colo.; Dr. William R. Humphrey, Denver, Colo.; Dr. Harvey Stallard, San Diego, Calif.

Awarded Honorary Degree by University of Montreal

Dr. Leuman M. Waugh, of New York City, former president of the American Association of Orthodontists and former professor of Orthodontics of Columbia University School of Dentistry, was awarded an honorary degree by the University of Montreal, May 30, 1952. The award was conferred in recognition of contributions made by Dr. Waugh in the field of dental education.

Federal Security Agency, Children's Bureau

Parents who have been baffled by children's "endless questions," by the "mess, confusion, and clutter" they make of their homes, by the gang "loyalties" that get in the way of parental discipline can get some help in understanding their youngsters from a publication just issued by the Children's Bureau.

The publication, issuance of which was announced today by Federal Security Administrator Oscar R. Ewing, of the Federal Security Agency, is entitled "A Healthy Personality for Your Child."

Dr. Martha M. Eliot, Chief of the Children's Bureau, reported that the publication is a popular version of a part of the Fact Finding Report on healthy personality development which was prepared for the Midcentury White House Conference on Children and Youth, which met in Washington in December, 1950.

The original report was the product of a committee which included doctors, psychologists, anthropologists, social workers, clergymen, delinquency experts, lawyers, educators, and specialists in youth employment, recreation, and child development.

This committee also had the benefit of scientific papers especially written for the Midcentury Conference by experts in many fields dealing with children.

Dr. James L. Hymes, Jr, Professor of Education, George Peabody College for Teachers, in Nashville, Tenn., is author of the popular version.

"A Healthy Personality for Your Child" puts together what is generally accepted by authorities on how personality grows and what shapes it this way and that. Written for parents, it attempts to give them an understanding of the stages through which children grow emotionally from infancy to adulthood.

Personality development, Dr. Eliot points out, "is not something that can be left to the doctors. It is the business of parents—but not of parents alone. Neighbors, teachers.

policemen, radio and television performers, writers, and all the myriad number of people who touch the thinking, feeling, acting person help to shape his personality as he grows throughout childhood.''

Of the stages through which a child grows emotionally, the booklet says an infant needs most of all ''a feeling that his world is O.K. . . . This hunger for a sense of trust—of sureness and of safety—IS infancy. But it goes on through all of life. Even when they have had a good full share of it, children keep coming back at times.''

Of 2-year-olds: ''They want to use themselves . . . throw their weight around . . . to button their own buttons and to feed themselves. . . . You show your love now most of all by giving him his freedom, but you also show it by holding him close when he is hurt or troubled or when he wants you near.''

Of 3, 4, and 5: ''Now he is ready to take his Self, the Self he knows is real, and put it to some more directed uses. . . . This is the reason that this age hangs around you. Their eyes are on you; they want to know how grown-ups act and what real jobs are like . . . the great age of make-believe . . . endless questions. . . . The youngster who gets the time to ask his questions, to see life going on, to play with a lot of make-believe, stands a good chance of developing an ability that we like.''

Of children 6 to 13: ''These are the years when it matters so much to youngsters to get good at something. They want to have the wonderful sense inside of them that they are skilled; that they can produce; that they are able. . . . If the youngster gets success, he grows. If school and home and club hold out on him and persuade him how dumb he is and how unable, he gets stuck and unhappy. . . .''

Of the adolescent: ''Many young people at this time in their growing feel at loose ends. . . . The uncertainties are there: What am I like? What will I become? What do people expect of me? . . . These people want to be treated with respect. They want to know from the way we approach them that they are nearing the time for being real equals. . . . [They particularly need] adults who will not be thrown for a loss by [their] strong feelings; adults who will be more easy-going in talking things over and firm-but-not angry in saying 'No' when they have to.''

Of the post-adolescent: ''He wants to gain strength now, not alone, but with others. He wants to be one with others, in friendship, in ideas, in hopes, in inspiration. It is the search for this that leads people to seek out a marriage that is a partnership of two equals.''

Single copies of ''A Healthy Personality for Your Child'' are available without charge, so long as the supply lasts, on request to the Children's Bureau, Federal Security Agency, Washington 25, D. C.

A Discussion Aid, based on this pamphlet, for use of parents' groups interested in exploring problems of emotional growth, is also available from the Children's Bureau, without charge.

Notes of Interest

Wyles B. Bunch, D.D.S., M.S.D., announces the removal of his office from Delray Beach, Fla., to 2701 Atlantic Blvd., Jacksonville, Fla.

Dr. Francis J. Loughlin announces the removal of his office to 8559 168th St., Jamaica, New York City, N. Y., practice limited to orthodontics.

Vernon E. Truetzel, A.B., D.D.S., M.S., announces the opening of his office at 8733 Riverview Blvd., St. Louis, Mo., practice limited to orthodontics.

Dr. Chas. R. Crook announces the opening of his offices on July 1, 1952, at 118 Professional Center, Montgomery, Ala., practice limited to orthodontics.

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THE AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

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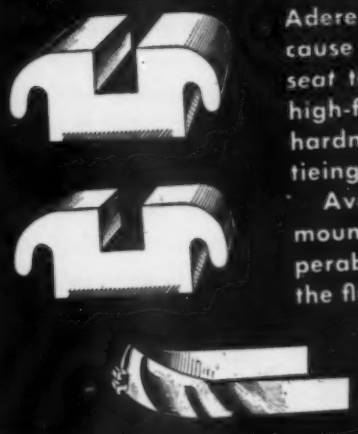

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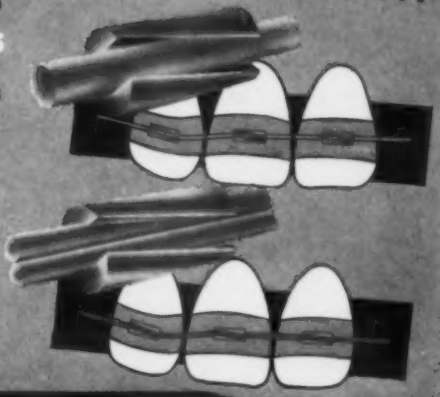

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MOST of the well-known books published in recent years deal primarily with that aspect of evolution and so do not meet the need for a broad survey. Introductory textbooks in biology provide such a survey, but their scope necessarily restricts it to a brief treatment from which many students fail to derive a comprehensive understanding. It is to meet the needs of those who want to learn more about evolution that this textbook is planned. It should be adequate for those who merely want to understand the subject as part of a liberal education, and, for those whose interest is seriously scientific, the inclusion of broad foundations of history and of the supporting evidence for the principle cannot interfere with the pursuit of the study to the ultimate frontiers of biological thought. Even though, as scientists of the future, they may already accept these foundations and may understand them fairly well, their more advanced study should be based on penetrating comprehension of all that the principle embraces.

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Organic evolution has continued through the years to be a corollary of other biological specialties. Few scientists are known primarily as evolutionists, but rather the outstanding evolutionists have been specialists in taxonomy, in paleontology, in comparative anatomy, and above all in genetics. The student who develops a deep scientific interest in evolution must, therefore, expect to attain detailed knowledge of other subjects. Excellent sources of such knowledge are available. It cannot be presented in a single textbook, and so this book does not pretend to be more than a broad introductory survey which may be enough for a liberal education and beyond that may be a guide for the logical evaluation of additional facts.

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